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Attachment 4

RECEIVED

GEOHYDROLOGIC EVALUATION
CABIN SPRINGS AREA
RED RIVER VALLEY
TAOS COUNTY, NEW MEXICO

PHASE II

PUMPING OF
COLUMBINE WELL 2
EFFECTS ON GROUND WATER,
SURFACE WATER, AND SPRINGS

Prepared for:

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November 27, 1996

GEOLOGY • GEOPHYSICS • GROUND WATER HYDROLOGY

PROJECT TEAM

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E. N. Perez	Data Collection and Data Analysis
K. E. Holmes	Data Collection
D. W. Bauer	Graphics
R. A. Sorensen	Technical Review

Under the supervision of:

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CG #125

CONTENTS

REFERENCES USED

GSi/water, 8/96, Preliminary Geohydrologic Investigation of Cabin Springs and Portal Springs Red River Valley Taos County, New Mexico: Prepared for Molycorp, Inc., Questa Division.

Molycorp, Inc., Base Maps of the Cabin Springs Area, Scale: 1:600.

United States Department of the Interior Geological Survey, 1963, 7 1/2 Minute Topographic Map, Red River, New Mexico.

Vail Engineering, Inc., 7/93, Interm Study of the Acidic Drainage to the Middle Red River, Taos County, New Mexico: Prepared for Molycorp, Inc., Questa Division.

INTRODUCTION

Figure 1: Project Location

This report presents the results of our Phase II geohydrologic investigation of the Cabin Springs area near Molycorp's mine facility at Questa, New Mexico (Figure 1). The objectives were to: 1) Investigate the nature of local water contributions to the springs; and 2) Assess the interrelationship of the geology, aquifer(s), springs, and river as controlling the formation of a white-gray precipitate (reportedly the precipitate is aluminum hydroxide; Vail, 7/93).

The results were used to recommend preliminary mitigation strategies to reduce or eliminate spring flow and to reduce or eliminate the formation of the aluminum hydroxide precipitate.

To accomplish the objectives, we designed a test pumping and analysis program for the Cabin Springs area. The program consisted of pumping Columbine Well 2 and monitoring the responses of the aquifer(s), springs, and river. The program was modified from recommendations made in our Phase I report (GSi/water, 8/96).

The field work was done from September 15 through October 21, 1996. The work included:

- Drilling oversight, design and installation of eight observation wells (P-1, P-2, P-3, P-4a, P-4b, P-5a, P-5b, and P-5c);
- Monitoring water levels and water level changes in the observation wells, Columbine Wells 1 and 2, and the Company Cabins Well;
- Monitoring changes in electrical conductivity (EC), pH, temperature, and flow at the springs and in the river;
- Measuring temperatures and temperature changes within the river bottom;
- Measuring the vertical distribution of temperatures and temperature changes in the wells; and
- Measuring changes in EC and pH in the wells.

The drilling and construction of P-1 and P-5a were done by Geo-Test, Inc. of Santa Fe, New Mexico using a hollow-stem auger. Air-rotary drilling with an ODEX casing advance system was used to drill the other wells. This was because the lithologies encountered did not accommodate a hollow-stem auger method. The air-rotary drilling was done by Drilling Services, Inc. of Chandler, Arizona.

We would like to thank Mr. Geyza Lorinczi of Molycorp, Inc. for facilitating our work in the field and Mr. Ralph Vail of Vail Engineering, Inc. for coordinating with Geo-Test, Inc. and for his assistance with the data collection.

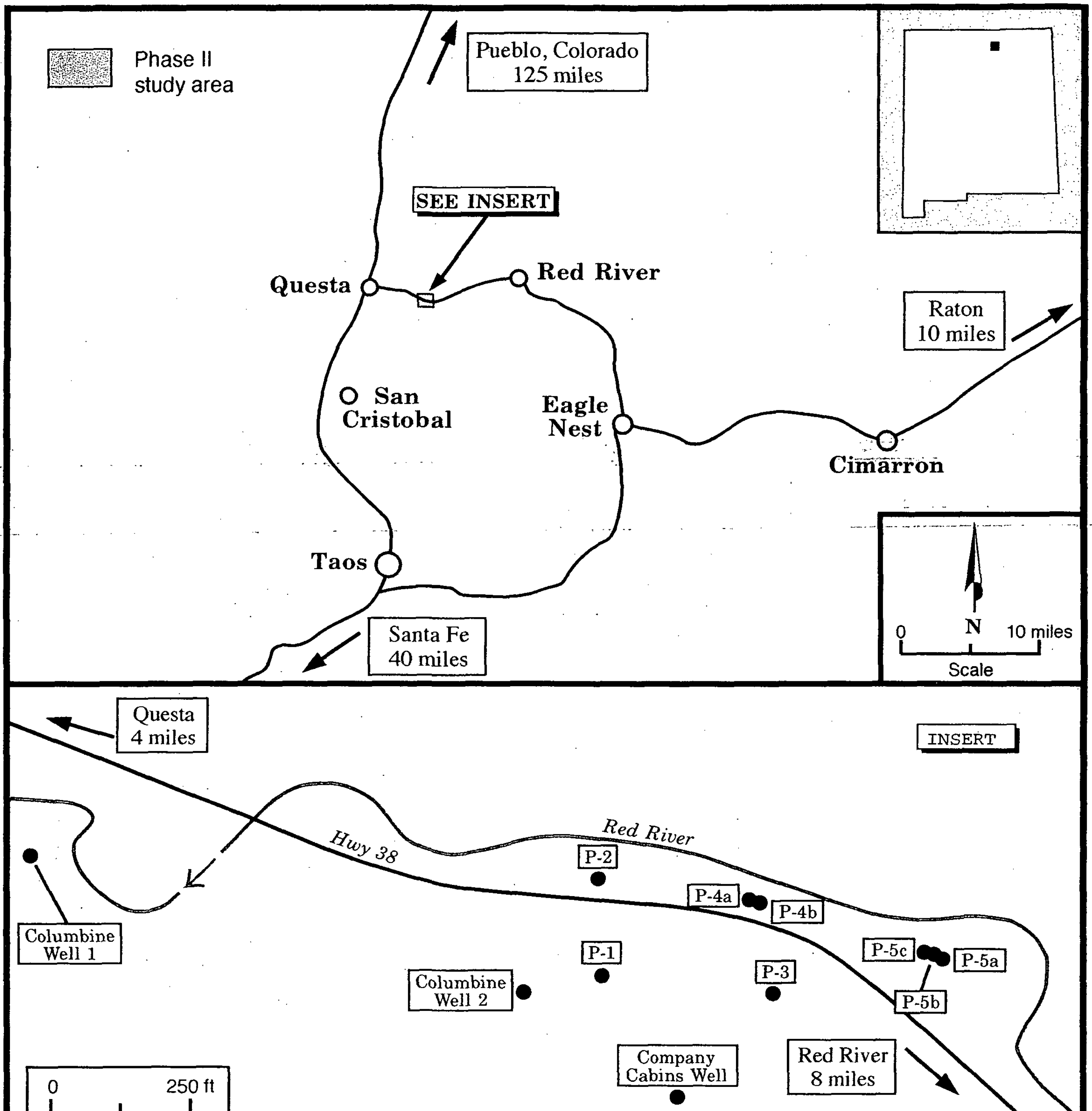


Figure 1
PROJECT LOCATION
Molycorp, Inc.
Questa, New Mexico
11/22/96 GSi/water

SETTING

Figure 2: Geologic Setting, Observation Wells and Monitoring Points

The surface geology in the Cabin Springs area (Figure 2) consists of crystalline granitic bedrock overlain in part by unconsolidated to semi-consolidated sands, silts, cobbles, and boulders (GSi/water, 8/96). The most distinctive sedimentary unit is the dark gray-brown, semi-consolidated debris flow (oa_2). This unit crops-out along the Red River and is coincident in part with the occurrence of aluminum hydroxide precipitate.

To assess how the geology, aquifer(s), springs, and river contribute to the formation of the precipitate, we stressed the local hydrologic system. This was done by pumping Columbine Well 2. Data were collected from the observation wells and monitoring points (Figure 2) before, during, and after the pumping.

During the drilling of the observation wells, we collected and identified lithologic samples at a minimum of 5 ft intervals. We also analyzed water samples at 20 ft intervals for EC, pH and temperature. These data (Appendix A) were used to interpret vertical changes in aquifer characteristics and to aid in the design of the observation wells (Appendix A). The purpose of each observation well is discussed below.

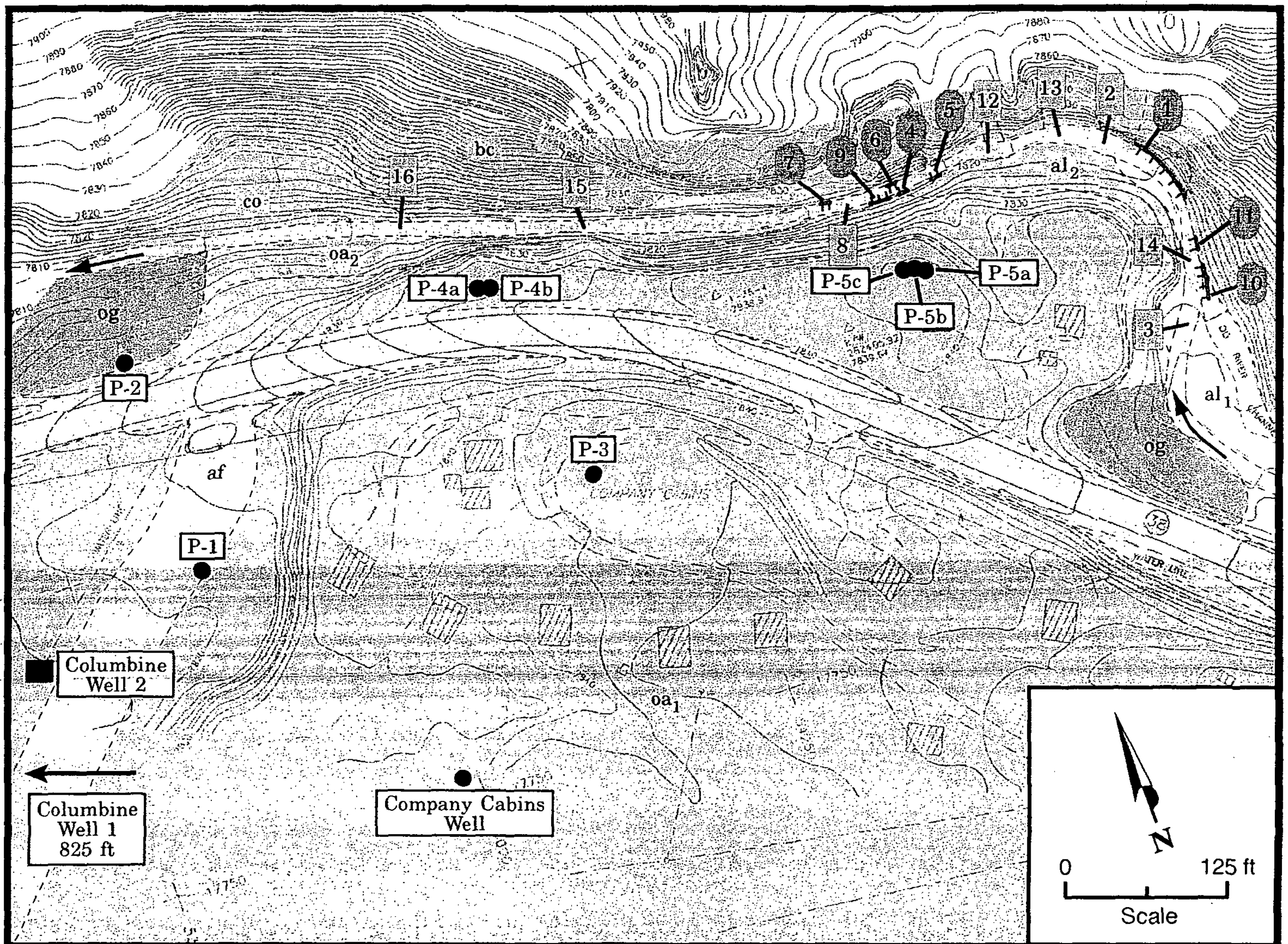
P-1 is screened from 28 ft to 118 ft depth. Its location enabled us to monitor the early response of the alluvial aquifer to the pumping of Columbine Well 2.

P-2 is screened from 16 ft to 36 ft depth. Its location enabled us to monitor how possible recharge from the river influenced the expanding pumping depression.

P-3 is screened from 42 ft to 102 ft depth. Its location enabled us to monitor the response of the alluvial aquifer as the pumping depression expanded toward the Cabin Springs area.

P-4a and P-4b were used to monitor two units within the alluvial aquifer identified during the drilling. P-4a is screened from 15 ft to 25 ft depth within the dark gray-brown debris flow (oa_2). P-4b is screened from 77 ft to 82 ft depth within the tan, unconsolidated Valley Fill (oa_1). There was also an unsuccessful attempt made to install a well into the bedrock aquifer at this location. Wells P-4a and P-4b are adjacent to an area of the Red River where we observed suspended aluminum hydroxide during our Phase I investigation.

P-5a, P-5b, and P-5c were used to monitor three aquifer zones identified at this location. P-5a is screened from 19 ft to 24 ft depth within the dark gray-brown debris flow (oa_2). P-5b is screened from 48 ft to 53 ft depth within the tan, unconsolidated Valley Fill (oa_1). P-5c is screened from 100 ft to 105 ft depth within the crystalline bedrock (bc). These wells were used to monitor how the three aquifer zones interrelate to the springs and river.



Base map from Molycorp, Inc.

Explanation

af	Artificial fill
al_1	Light brown - tan, subangular to subrounded, unconsolidated sand and gravel, with minor organics. Stream channel deposit.
og	Light - medium brown, subangular to subrounded, poorly consolidated silt, sand, and gravel, suspended in a matrix of organic material. Stream channel deposit.
al_2	Light brown - tan, subangular to subrounded, unconsolidated silt and sand with minor gravel. Stream channel deposit.
oa_1	Tan - orange brown, angular to subrounded, poorly consolidated, sand and gravel in a silt / clay matrix. Stream channel and debris flow deposit.
oa_2	Dark gray to brown debris flow. Angular to subrounded sand and gravel in a matrix of light gray to black silt. Moderately cemented forming nearly vertical walls. The matrix appears to be stained with limonite.
co	Angular to subangular gravel deposited as colluvium. Likely derived from the surrounding outcrops of granitic bedrock.
bc	Bedrock - predominantly granite and quartz monzonite
------	Geologic contact
P-3	Observation well
■	Pumping well
←	Direction of river flow
1	Spring monitoring point
3	River monitoring point
	Spring. Ticks show direction of flow

Figure 2

GEOLOGIC SETTING, OBSERVATION WELLS, AND MONITORING POINTS

Molycorp, Inc.
Questa, New Mexico

11/21/96 *GSi / water*

DISTANCE DRAWDOWN RELATIONSHIP

Figure 3a: Pumping Depression
Figure 3b: Distance Drawdown Relationship

Typically, when ground water is pumped from a well, a pumping depression in the ground water surface is created. This pumping depression expands until the rate of recharge is equal to the rate of discharge from the well. The shape and reach of the pumping depression is dependent upon the rate of pumping and the geologic and hydrologic characteristics of the aquifer.

The pumping of Columbine Well 2 began at 5:38 am on October 2, 1996. The well was pumped at a continuous rate of about 2000 gallons per minute (gpm). We monitored water levels in the wells before and during the pumping. We also monitored water level recovery in the wells after the pumping was stopped. A complete set of water level data is in Appendix B.

Figure 3a shows the pumping depression generated from Columbine Well 2 after about 15 days of continuous pumping. Figure 3b shows the relationship between distance and drawdown for the observation wells monitored during the pumping test. Time-drawdown data are in Appendix B.

The pumping depression appears to have intercepted the river throughout the area shown on Figure 3a. This is evident by the water level declines in the wells immediately adjacent to the river. The apparent asymmetry of the pumping depression may be due in part to in-flow to the aquifer through the river bottom.

Figure 3a illustrates that the influences from pumping expanded to at least the western end of the Cabin Springs area. This is evident by the decline in water levels in the P-5 cluster well set.

The relationship between distance from the pumping well and drawdown is important when assessing the hydrologic characteristics of an aquifer. Data that plot linearly on a semi-logarithmic graph indicate an isotropic and homogeneous aquifer system. Data that do not plot linearly may result from aquifer asymmetry, aquifer boundaries, anisotropy, heterogeneity, and/or a variety of other variables. The slope of a line drawn through the data points can be used to estimate the ground water transmitting capacity of the aquifer (transmissivity).

Figure 3b shows two data sets. One illustrates drawdown in the wells 6 days after pumping began; the other illustrates drawdown after 15 days of pumping. After 6 days of pumping, Columbine Well 1 and the Company Cabins Well plotted below the other wells. Both of these wells were pumped intermittently during the test, likely causing the additional drawdown. After 15 days of pumping, the wells closest to the river plotted above the other wells. We interpret this was caused by recharge to the aquifer through the river bottom.

The transmissivity of the alluvial aquifer (Figure 3b) is about 200,000 gpd/ft width of aquifer. This is in general agreement with the transmissivity values calculated from the time-drawdown data (Appendix B).

We calculated the storativity of the alluvial aquifer to be about 0.44. This indicates that the aquifer system is unconfined.

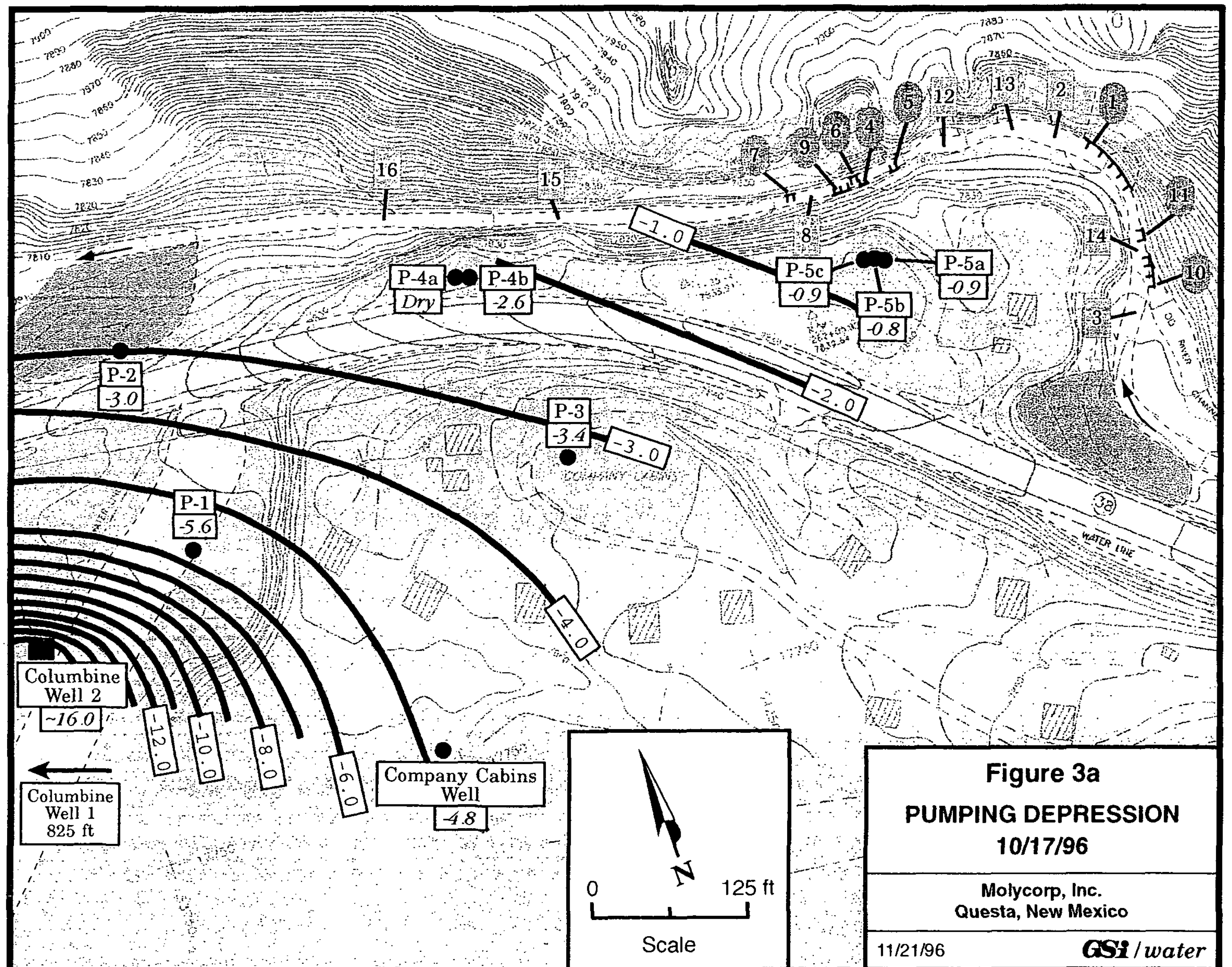


Figure 3a
PUMPING DEPRESSION
10/17/96

Molycorp, Inc.
Questa, New Mexico

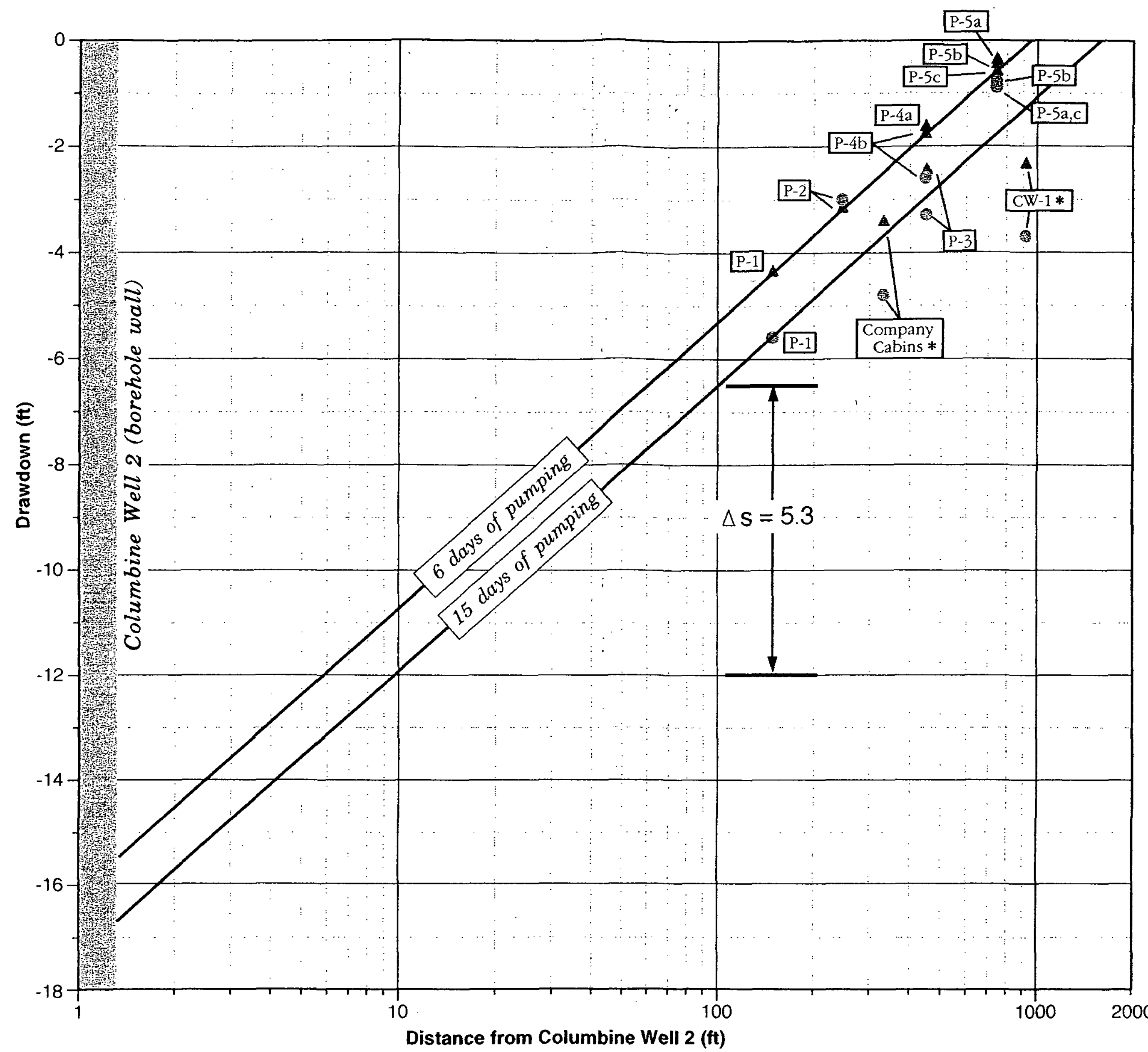
11/21/96 GSi/water

Explanation

af	Artificial fill
al_1	Light brown - tan, subangular to subrounded, unconsolidated sand and gravel, with minor organics. Stream channel deposit.
og	Light - medium brown, subangular to subrounded, poorly consolidated silt, sand, and gravel, suspended in a matrix of organic material. Stream channel deposit.
al_2	Light brown - tan, subangular to subrounded, unconsolidated silt and sand with minor gravel. Stream channel deposit.
oa_1	Tan - orange brown, angular to subrounded, poorly consolidated, sand and gravel in a silt / clay matrix. Stream channel and debris flow deposit.
oa_2	Dark gray to brown debris flow. Angular to subrounded sand and gravel in a matrix of light gray to black silt. Moderately cemented forming nearly vertical walls. The matrix appears to be stained with limonite.
co	Angular to subangular gravel deposited as colluvium. Likely derived from the surrounding outcrops of granitic bedrock.
bc	Bedrock - predominantly granite and quartz monzonite

- - - - - -	Geologic contact
-2.0	Line of equal drawdown (ft)
P-3 / -3.3	Well location and designation / Drawdown after 15 days of pumping
■	Pumping well
1	Spring monitoring point
3	River monitoring point
	Spring. Ticks show direction of flow
	Direction of river flow

Base map from Molycorp, Inc.



$Q = 2{,}000$ gpm
$\Delta S = 5.3$

$$T = \frac{528\,Q}{\Delta S} = 200{,}000 \text{ gpd/ft}$$

$T = 200{,}000$
$t = 6$ days
$r_0 = 900$ ft

$$S = \frac{0.3Tt_0}{r_0^2} = \frac{0.3(200{,}000)(6)}{900^2}$$

$S = 0.44$

* Pumped intermittently during pumping of Columbine Well 2
▲ Drawdown - 6 days of pumping
● Drawdown - 15 days of pumping

Figure 3b
DISTANCE DRAWDOWN RELATIONSHIP
10/17/96

Molycorp, Inc.
Questa, New Mexico

11/22/96 GSi/water

INTERRELATIONSHIP OF GROUND WATER, RIVER, AND SPRING FLOW

Figure 4a: Ground Water Configuration and Spring Flow: Before Pumping
Figure 4b: Ground Water Configuration and Spring Flow: During Pumping

We collected water level data from the wells and flow rates from the springs before, during, and after the pumping. A comparison the these data was done to help us assess the interrelationship among the aquifer(s), springs, and river.

Before Pumping (Figure 4a)

Figure 4a shows the general direction of ground water flow and the average flow from the springs before pumping Columbine Well 2. The figure also shows the vertical ground water gradients at well clusters. A complete set of data is in Appendix B.

We interpret that ground water near the central part of the valley (Company Cabins Well) generally flows to the west. This is indicated by the north-south-trending potentiometric contours.

The pre-pumping water level data in P-5a and P-5b show that the ground water in the alluvial aquifer was higher than the adjacent river level. This indicates that the river, in the area of the active springs, was receiving recharge from the alluvial aquifer.

The water level data in P-5c was at about the same elevation as the adjacent river level and lower than that in P-5a and P-5b. This indicates hydrologic equilibrium between the bedrock aquifer and the river. This also indicates downward gradients from the alluvium to the bedrock.

Water level data in wells downgradient from P-5 were generally lower than the adjacent river level. This indicates that the river, downstream from the springs, was losing to the alluvial aquifer.

During Pumping (Figure 4b)

The pumping of Columbine Well 2 began on October 2, 1996 at a continuous rate of about 2000 gallons per minute (gpm). The data on Figure 4b were collected after 15 days of pumping.

The influences from the pumping extended to the springs. This is indicated by the significant decrease in flow at the springs and water level declines in P-5a, P-5b, and P-5c.

The data shown on Figure 4b suggest that the bedrock aquifer contributes at least some water to the springs. This is indicated by the water level data in the P-5 cluster well set. The water level data in P-5a and P-5b remained higher than the river, indicating that the stream continued to gain from the alluvial aquifer. However, the water level in P-5c was lower than the river, indicating the river was losing to the bedrock. This was the same area in which spring flow was significantly reduced or eliminated during pumping.

The recovery data support the interpretations made from the pumping data. As the water level in P-5c recovered, flow at the springs resumed or increased. This indicates at least partial communication between the bedrock aquifer and the springs.

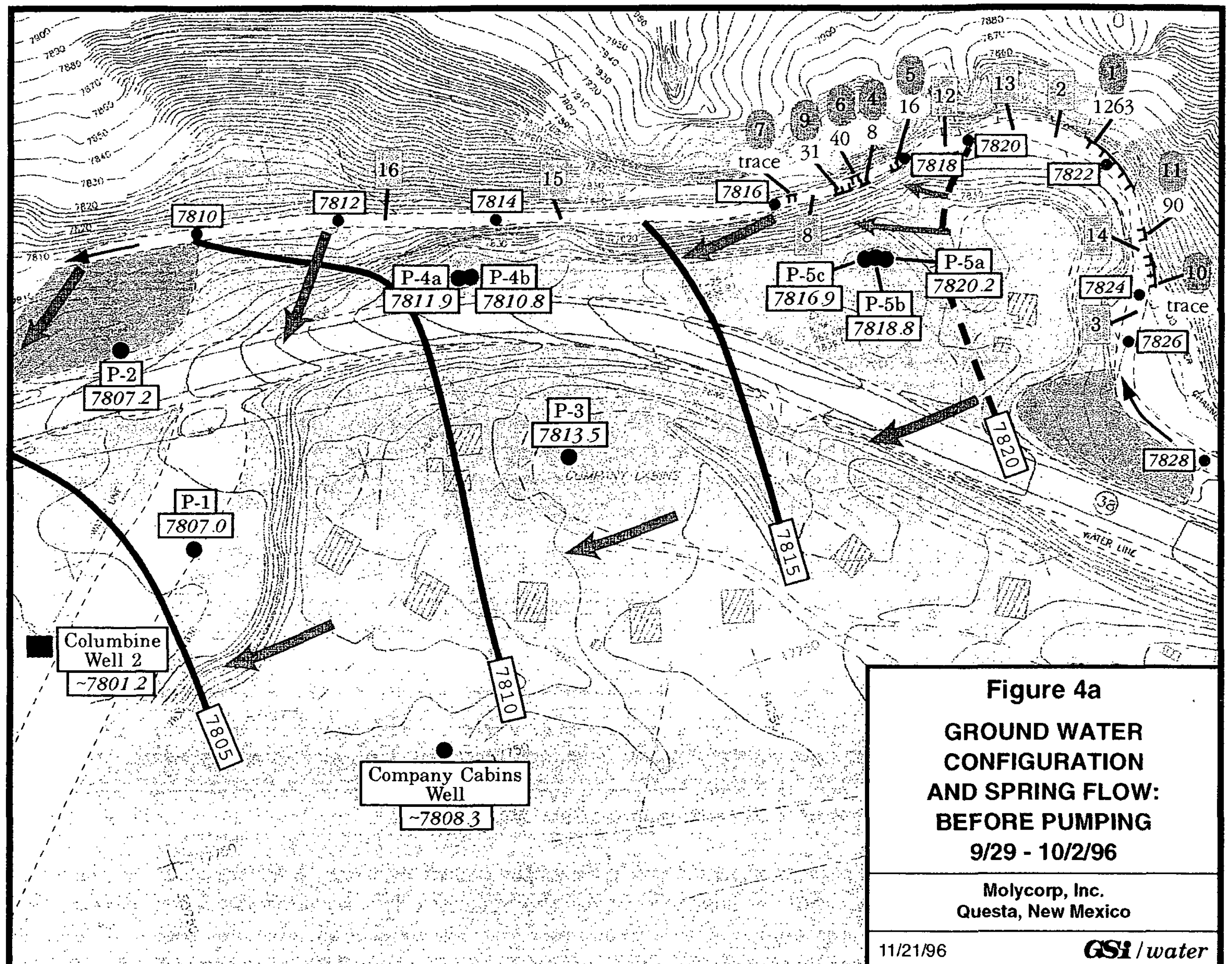


Figure 4a

GROUND WATER CONFIGURATION AND SPRING FLOW: BEFORE PUMPING 9/29 - 10/2/96

Molycorp, Inc.
Questa, New Mexico

11/21/96 *GSi/water*

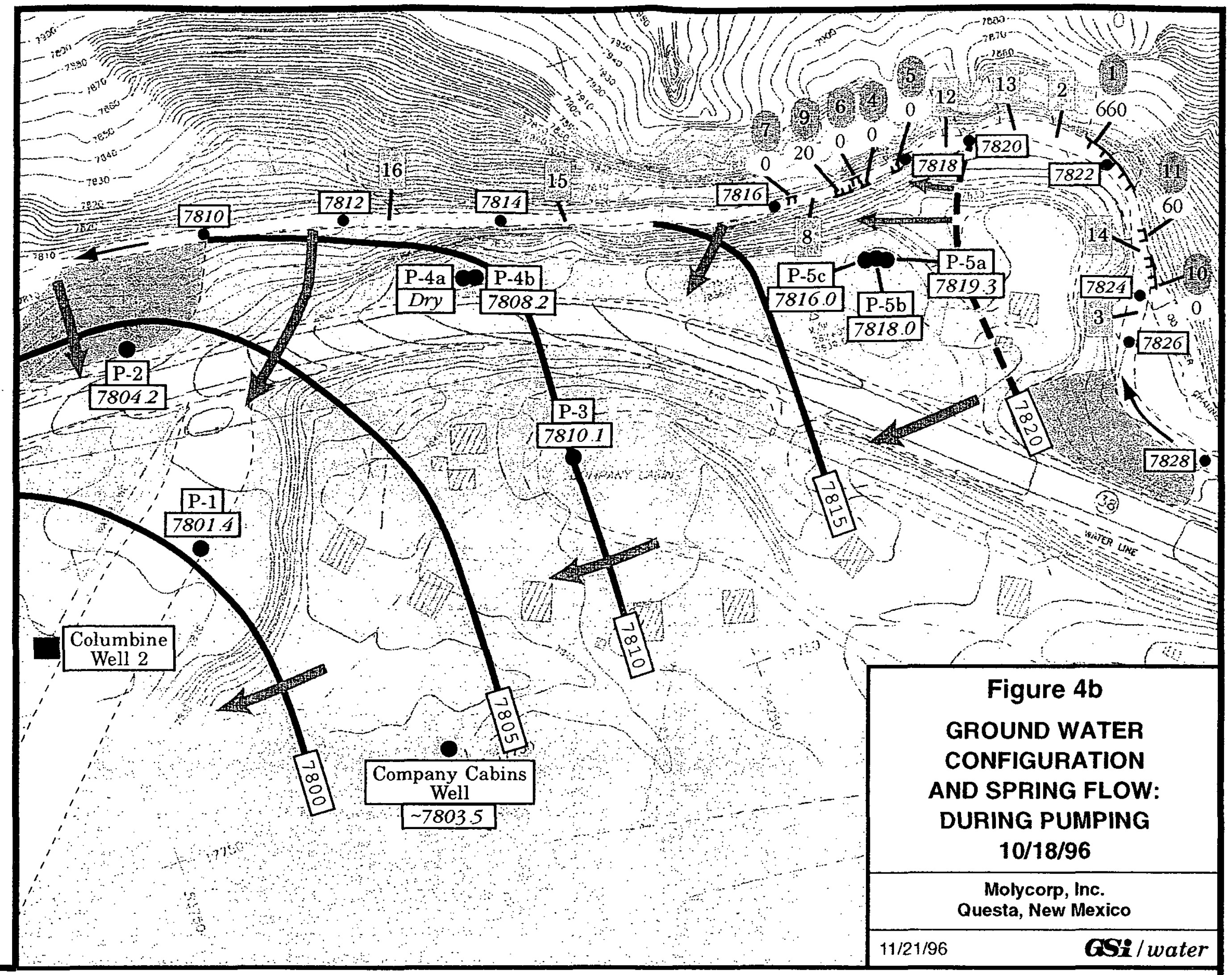


Figure 4b

GROUND WATER CONFIGURATION AND SPRING FLOW: DURING PUMPING 10/18/96

Molycorp, Inc.
Questa, New Mexico

11/21/96 *GSi/water*

Explanation

af	Artificial fill
al_1	Light brown - tan, subangular to subrounded, unconsolidated sand and gravel, with minor organics. Stream channel deposit.
og	Light - medium brown, subangular to subrounded, poorly consolidated silt, sand, and gravel, suspended in a matrix of organic material. Stream channel deposit.
al_2	Light brown - tan, subangular to subrounded, unconsolidated silt and sand with minor gravel. Stream channel deposit.
oa_1	Tan - orange brown, angular to subrounded, poorly consolidated, sand and gravel in a silt / clay matrix. Stream channel and debris flow deposit.
oa_2	Dark gray to brown debris flow. Angular to subrounded sand and gravel in a matrix of light gray to black silt. Moderately cemented forming nearly vertical walls. The matrix appears to be stained with limonite.
co	Angular to subangular gravel deposited as colluvium. Likely derived from the surrounding outcrops of granitic bedrock.
bc	Bedrock - predominantly granite and quartz monzonite

P-3 / 7813.4	Observation well Ground water elevation (ft above msl)
	Spring. Ticks show direction of flow
1 / 1263	Spring monitoring point flow (ml/min)
3	River monitoring point
7828	Approximate elevation of river (ft above msl)
7810	Line of equal ground water elevation (ft above msl) dashed where inferred; at well clusters, ("b" well contoured)
	Direction of ground water flow
	Direction of river flow
	Pumping well
	Geologic contact

N

0 125 ft
Scale

Base map from Molycorp, Inc.

000840

TEMPERATURE RELATIONSHIP OF GROUND WATER, SPRINGS, AND RIVER

Figure 5a: Temperatures of Ground Water, Springs, and River Sub-bottom: Before Pumping
Figure 5b: Temperatures of Ground Water, Springs, and River Sub-bottom: During Pumping

We measured temperatures at the springs; at mid-depth within the river; approximately 6 in below the bottom of the river; in the observation wells; and in the Company Cabins Well. Temperatures in the wells were measured at 5 ft intervals beginning 1 ft below the water level. At well clusters, we logged the deepest well. This provided us with the vertical temperature distribution throughout all of the aquifer zones penetrated.

Before Pumping (Figure 5a)

The temperatures in the ground water became cooler with increasing depth (negative thermal gradient). We interpret this to result from a depth-related increase in ground water activity. P-5c shows relatively cool temperatures and a negative thermal gradient at the bottom of the well. This indicates that the active ground water movement continued into the bedrock.

Ground water temperatures decreased toward the center of the valley (Company Cabins Well). We interpret this to result from more active ground water movement, likely resulting from active recharge from Columbine Creek.

Before pumping, the temperatures below the river bottom were generally colder and more stable than those in the river (Appendix C). This was particularly true near monitoring point 8 (MP-8), suggesting that ground water was rising into the river in the area of the springs, possibly from the bedrock. This interpretation is supported by the similarity in temperatures in the middle to lower part of P-5c with those measured in the adjacent river bottom.

The warm ground water temperatures in the upper part of P-5c are likely attributed in part to influences from the seasonal temperature cycle. This indicates that the dark gray-brown debris flow, in which these warm temperatures occur, has a relatively low transmissivity value. The similarity in spring temperatures with those in the middle to upper part of P-5c indicates that water flow to the springs may be shallow, also within the influence of the seasonal temperature cycle.

During Pumping (Figure 5b)

The data show that: River bottom temperatures remained about the same in the area of MP-8; river sub-bottom temperatures decreased significantly upstream of MP-8; temperatures in the lower part of the wells remained about the same; temperatures in the upper part of the wells became cooler; and the springs stopped flowing (MP-10, -5, -4, -6, -9, and -7) or had reduced flow and became cooler (MP-1 and-11), similar to the temperature changes below the river bottom.

From these observations, we interpret that deeper ground water, possibly from the bedrock, was drawn upward into the alluvial aquifer during pumping. This suggests that the downward gradient (alluvial to bedrock aquifer) indicated from the water level data may represent only localized conditions. We also interpret that the river continued to receive some recharge in the area of MP-8, possibly from the bedrock. The decrease in river sub-bottom temperatures, upstream from MP-8, is likely attributed to influences from ambient air temperatures.

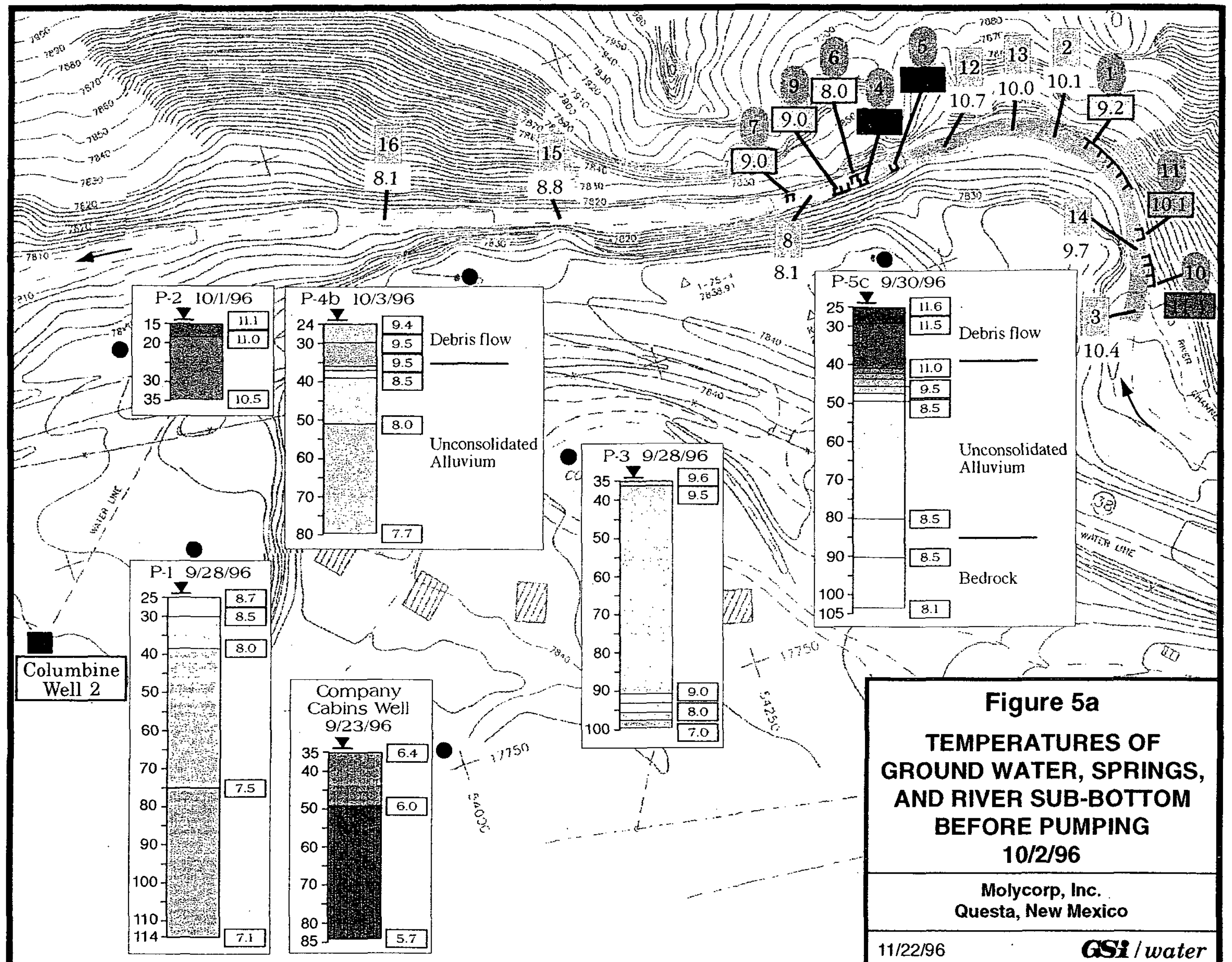


Figure 5a
TEMPERATURES OF GROUND WATER, SPRINGS, AND RIVER SUB-BOTTOM BEFORE PUMPING 10/2/96
Molycorp, Inc.
Questa, New Mexico
11/22/96
GSi / water
P-2 10/1/96
P-4b 10/3/96
P-3 9/28/96
P-5c 9/30/96
P-1 9/28/96
Company Cabins Well 9/23/96
Columbine Well 2
Debris flow
Unconsolidated Alluvium
Bedrock

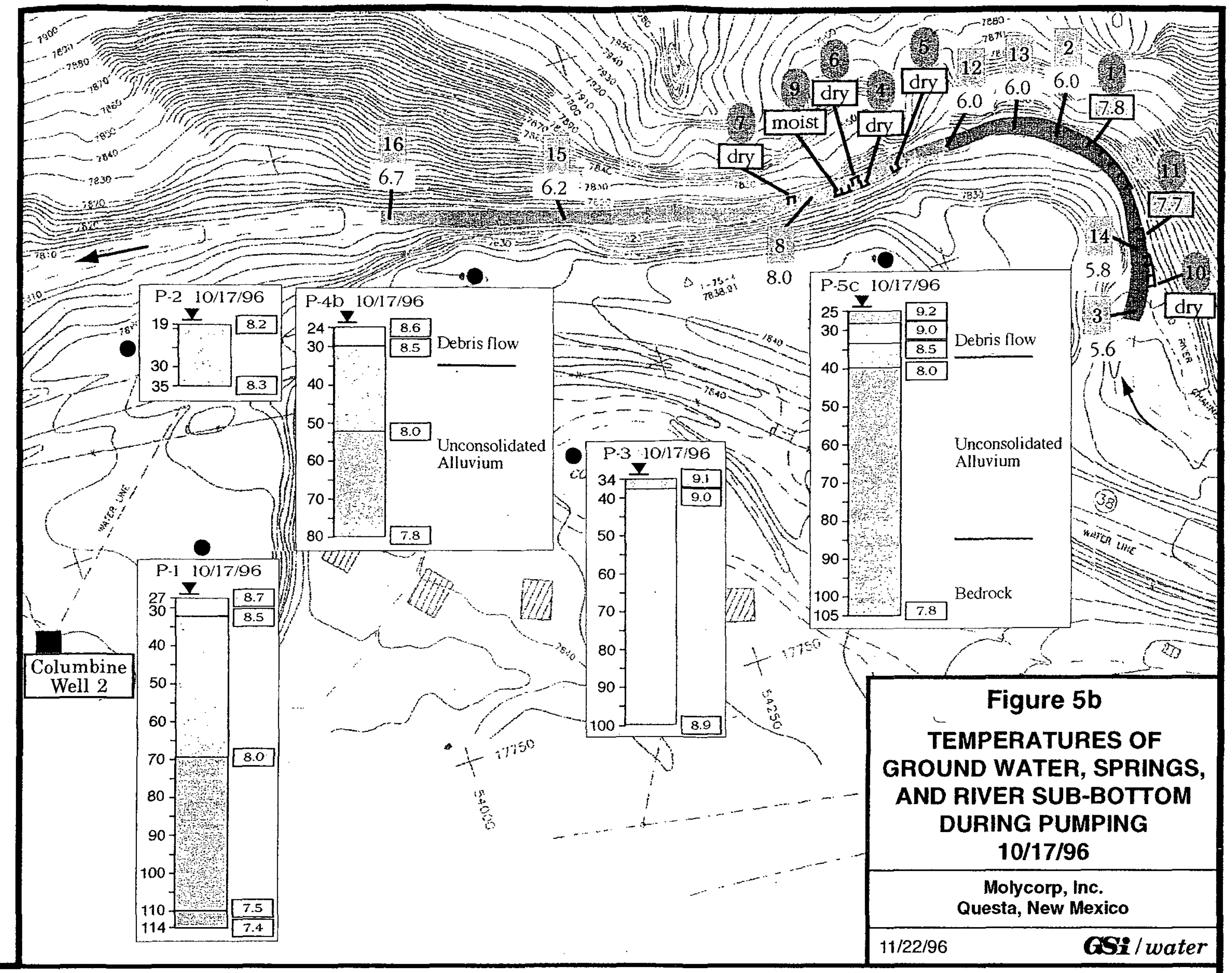
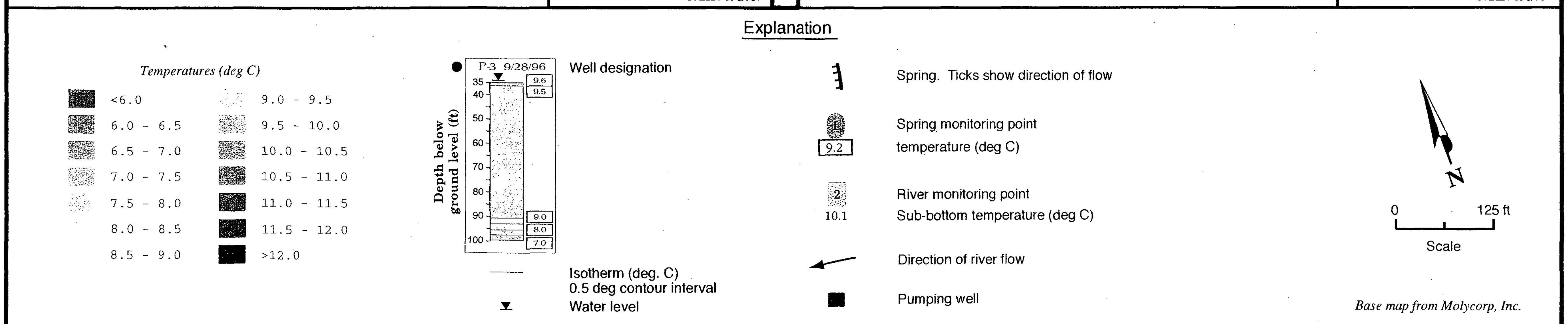


Figure 5b
TEMPERATURES OF GROUND WATER, SPRINGS, AND RIVER SUB-BOTTOM DURING PUMPING 10/17/96
Molycorp, Inc.
Questa, New Mexico
11/22/96
GSi / water
P-2 10/17/96
P-4b 10/17/96
P-3 10/17/96
P-5c 10/17/96
P-1 10/17/96
Columbine Well 2
Debris flow
Unconsolidated Alluvium
Bedrock


Explanation
Temperatures (deg C)
<6.0
6.0 - 6.5
6.5 - 7.0
7.0 - 7.5
7.5 - 8.0
8.0 - 8.5
8.5 - 9.0
9.0 - 9.5
9.5 - 10.0
10.0 - 10.5
10.5 - 11.0
11.0 - 11.5
11.5 - 12.0
>12.0
P-3 9/28/96
Depth below ground level (ft)
Well designation
Isotherm (deg. C)
0.5 deg contour interval
Water level
Spring. Ticks show direction of flow
Spring monitoring point temperature (deg C)
River monitoring point Sub-bottom temperature (deg C)
Direction of river flow
Pumping well
N
0
125 ft
Scale
Base map from Molycorp, Inc.

pH RELATIONSHIP OF GROUND WATER, SPRINGS, AND RIVER

Figure 6a: pH Values in Ground Water, Springs, and River Water: Before Pumping
Figure 6b: pH Values in Ground Water, Springs, and River Water: During Pumping

We measured pH and EC (Appendix D) at the springs; in the river; and in the observation wells. The pH values were used for contouring because pH likely has the greatest influence on the formation of the aluminum hydroxide precipitate (Vail, 7/93).

Before Pumping (Figure 6a)

The pH values of the springs ranged from about 4.7 to 5.5, indicating an acidic water source.

The pH values of the ground water south of the river were generally less than 6.0. One hypothesis is that acidic contributions from north of the river have lowered the pH values within the aquifer(s) south of the river. However, We can expect that the sediments and bedrock contain some hydrothermal scar material. Therefore, the acidity of the ground water may also result at least in part from the composition of the sediments and the bedrock through which it moves.

The pH values in the river, upstream from the springs, were about neutral (6.9) and generally decreased (6.7 to 6.0) downstream through the spring area. This indicates that the springs and/or aquifer(s) contributed enough acidic water to the river to effectively lower the pH values.

The pH values within the river, downstream from the springs, were about neutral (6.8 to 7.0). This is the same area in which we observed a heavy accumulation of aluminum hydroxide precipitate. The neutral pH values may have resulted from dilution from another water source and/or from a chemical reaction, possibly associated with the formation of the aluminum hydroxide precipitate. In-house experiments have shown that the dark gray-brown debris flow material that occurs within this area of the river (Figure 2) increases the pH values of acidic (low pH) solutions.

The pH values in the P-5 cluster well set showed less acidic water in the bedrock (P-5c) when compared with that in the alluvium (P-5a and -5b). This may result from dilution from the river water. Hydrologic communication between the bedrock aquifer and the river was indicated from the water level and temperature data.

During Pumping (Figure 6b)

In the ground water, pH values became more acidic in the area of the springs and more alkaline in wells away from the springs. In the river, pH values became less acidic in the area of the springs. Of the active springs, some may have become slightly more acidic; others may have become slightly more alkaline. However, the pH changes at the springs were relatively small, possibly within measurement error of the field equipment.

We interpret that the decrease in pH values of the ground water near the springs resulted from acidic spring water being drawn toward the pumping depression. The increase in pH values of the ground water away from the springs likely resulted from contributions from more active ground water flow near the center of the valley. We interpret that the increase in pH values of the river water resulted from a smaller quantity of acidic water being contributed to the river.

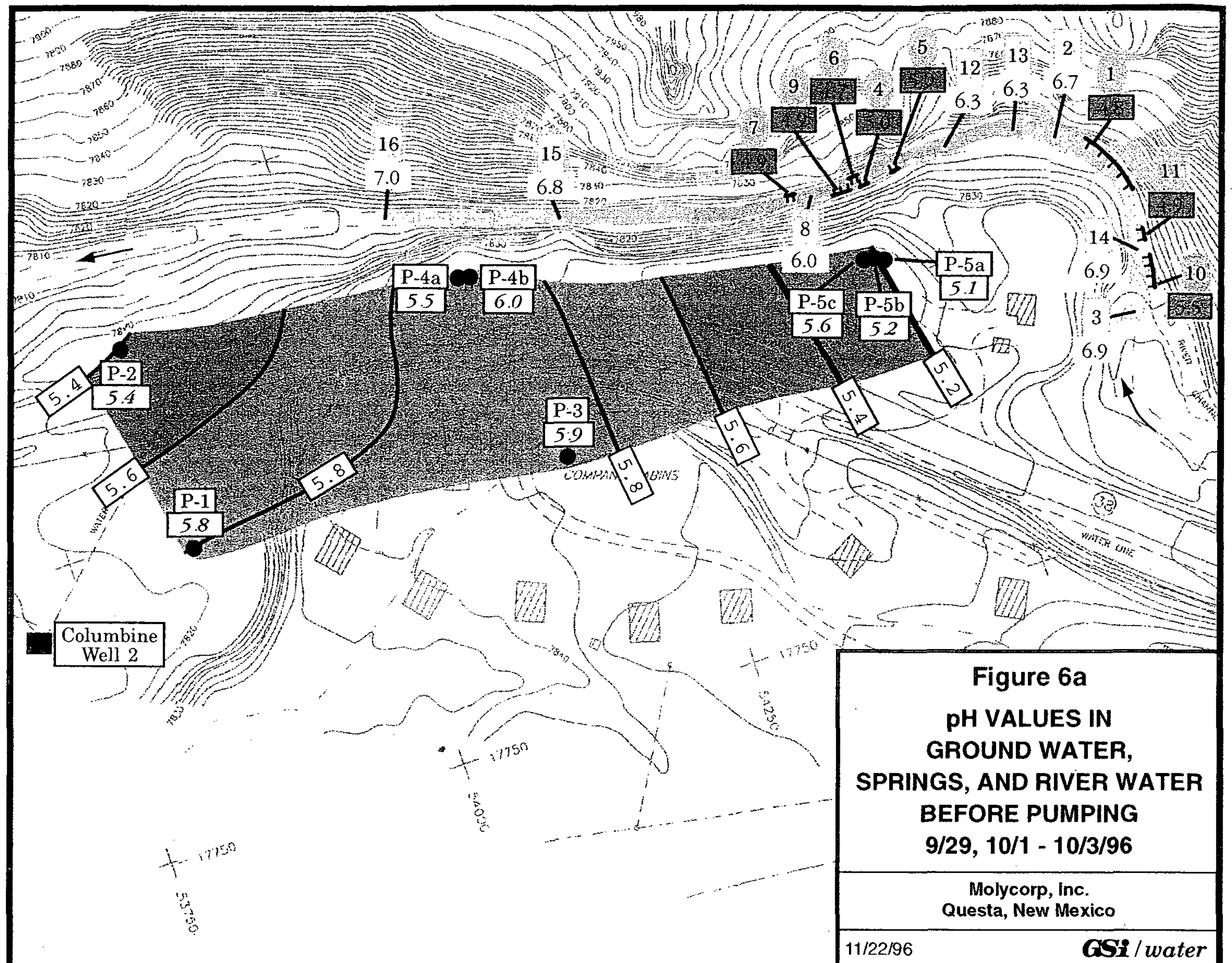


Figure 6a
pH VALUES IN GROUND WATER, SPRINGS, AND RIVER WATER BEFORE PUMPING
9/29, 10/1 - 10/3/96
Molycorp, Inc.
Questa, New Mexico
11/22/96 GSi / water

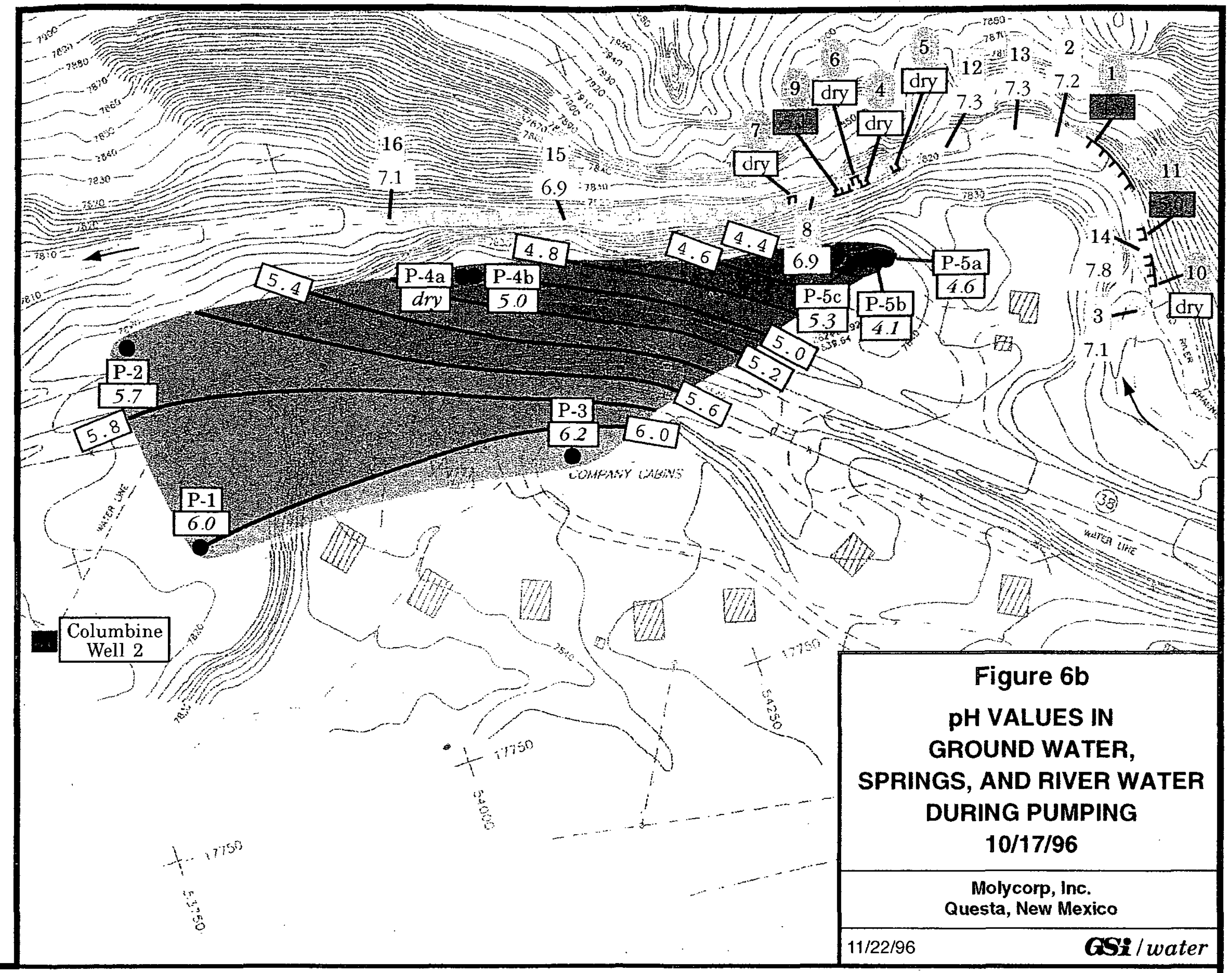


Figure 6b
pH VALUES IN GROUND WATER, SPRINGS, AND RIVER WATER DURING PUMPING
10/17/96
Molycorp, Inc.
Questa, New Mexico
11/22/96 GSi / water

Explanation

pH

- <4.4
- 4.4 - 4.8
- 4.8 - 5.2
- 5.2 - 5.6
- 5.6 - 6.0
- 6.0 - 6.4
- 6.4 - 6.8
- 6.8 - 7.2
- >7.2

5.6 — Line of equal pH value, contour interval = 0.2 pH units

P-3 / 5.9 — Well location and designation, pH (at well clusters, alluvial well "b" used for contouring)

Spring. Ticks show direction of flow

1 — Spring
4.8 — pH value

2 — River monitoring point
6.7 — pH value within river

Direction of river flow

Pumping well

N

0 125 ft
Scale

Base map from Molycorp, Inc.

SUMMARY - OBSERVATIONS

	Before Pumping	During Pumping	After Pumping
Ground Water and Spring Flow	**a.** Water level in alluvial aquifer higher than adjacent river level in spring area. **b.** Water level in alluvial aquifer lower than adjacent river level downstream from springs. **c.** Water level in bedrock aquifer about the same as adjacent river level in spring area.	**a.** Water level in alluvial aquifer higher than adjacent river level in spring area. **b.** Water level in alluvial aquifer lower than adjacent river level downstream from springs. **c.** Water level in bedrock aquifer lower than adjacent river level in spring area. **d.** Spring flow was reduced or stopped.	**a.** Water level in alluvial aquifer higher than adjacent river level in spring area. **b.** Water level in alluvial aquifer lower than adjacent river level downstream from springs. **c.** Water level in bedrock aquifer began to approach that of the adjacent river level. **d.** Spring flow increased or resumed compared with that during pumping.
Temperature	**d.** Depth-related decrease in ground water temperatures. **e.** Cooler ground water temperatures near center of valley. **f.** Temperatures below river bottom cooler and more stable than in the river. Particularly near springs **g.** Ground water temperatures relatively warm within the dark gray-brow debris flow. **h.** Spring temperatures relatively warm.	**e.** Temperatures in the upper part of wells decreased, becoming similar to those in the bedrock. **f.** Temperatures below river bottom continued to be cooler and more stable than those in the river, particularly near MP-8. **g.** Temperatures below river bottom became cooler in the area of the springs. **h.** Spring temperatures became cooler.	**e.** Temperatures in river bottom cooler and more stable than those in the river. **f.** As spring flow increased or resumed, spring temperatures began to increase.
Water Quality	**i.** Low pH values at springs **j.** River more acidic in area of springs. **k.** River less acidic downstream from springs. **l.** Ground water slightly acidic (generally <6.0).	**i.** Increase in river water pH values in area of springs. **j.** Ground water more acidic near area of springs. **k.** Ground water less acidic away from springs.	**g.** River water in area of springs became more acidic compared with that during pumping. **h.** pH of ground water generally increased near area of springs.

SUMMARY - INTERPRETATIONS

	Before Pumping	During Pumping	After Pumping
Ground Water and Spring Flow	**a.** River gaining in area of springs from alluvial aquifer. **b.** River losing to aquifer downstream from springs. **c. River and bedrock aquifer in hydrologic equilibrium in area of springs.**	**a.** River gaining in area of springs from alluvial aquifer. **b.** River losing to aquifer downstream from springs. **c.** River losing to bedrock aquifer in area of springs. **d. At least partial hydrologic communication between springs and bedrock aquifer.**	**a.** River gaining in area of springs from alluvial aquifer. **b.** River losing to aquifer downstream from springs. **c.** Bedrock aquifer and river begin to approach hydrologic equilibrium. **d. At least partial hydrologic communication between springs and bedrock aquifer.**
Temperature	**d.** Depth-related increase in ground water activity. **e.** Increased ground water flow near the center of the valley. **f.** Ground water rising into river bottom in area of springs. **g.** Ground water in debris flow shows influences from ambient temperature cycle, indicating low transmissivity. **h. Water flow to the springs relatively shallow, within influence of ambient temperature cycle.**	**e.** Ground water drawn up from deep alluvium or the bedrock. **f.** Ground water rising into river bottom, particularly near MP-8. **g.** River bottom temperatures show influence from ambient air temperatures. **h. Spring temperatures show influence from ambient air temperatures, indicating relatively shallow flow.**	**e.** Ground water rising into river bottom, particularly near MP-8. **f. Spring temperatures show influence from ambient air temperatures, indicating relatively shallow flow.**
Water Quality	**i.** Springs have acidic water source(s). **j.** Springs and/or aquifer(s) contribute acidic water to river. **k.** Dilution or chemical reaction associated with the aluminum hydroxide. **l. Hydrothermal scar material occurs within the sediments and bedrock.**	**i.** Less acidic water contributions to the river. **j. Acidic spring water drawn toward the pumping depression.** **k.** Dilution from ground water near center of the valley.	**g.** Acidic contributions from springs and/or aquifer to the river as ground water levels recovered. **h.** Acidic spring water no longer drawn away from springs.

DISCUSSION

Figure 7: Diagramatic Cross-section with Extraction Well

Data collected during this investigation indicate that the pumping of Columbine Well 2 reduced the amount of acidic water that flowed into the springs and river. The data also indicate that much of the spring flow may be coming from relatively shallow depths, likely from the bedrock along the north side of the river.

In-field water quality data show that the ground water on the south side of the river is mildly acidic. This may be in part from sources north of the river. Based on the geologic setting, we can expect that the sediments and bedrock contain some hydrothermal scar material. Therefore, the acidity of the ground water may result at least in part from the composition of the sediments and the bedrock through which it moves.

The cropping-out of the dark gray-brown debris flow, downstream from the springs, is coincident with the occurrence of suspended aluminum hydroxide; and is coincident with higher pH values within the river water. Therefore, a relationship may exist between the aluminum hydroxide precipitate and the occurrence of the dark gray-brown debris flow.

A mitigation strategy for the springs and the aluminum hydroxide precipitate would be to install wells as interception facilities. Figure 7 shows how a well might be used to intercept acidic water flow to the springs and river.

From the results of this investigation, we interpret that extraction wells that are properly located and designed could effectively intercept much of the acidic water contributions to the springs and river. Constructing the wells into the bedrock would minimize the amount of ground water extracted from the alluvial aquifer while intercepting and removing the acidic water that flows through the bedrock in the Cabin Springs area. Flow from the wells could be regulated to control the amount of water intercepted and to minimize adverse impacts to the local hydrologic system.

The locations, depths, and spacing of wells would be dependent primarily upon the hydrologic characteristics of the bedrock aquifer. Consideration would also be given to accessibility to the recommended well locations.

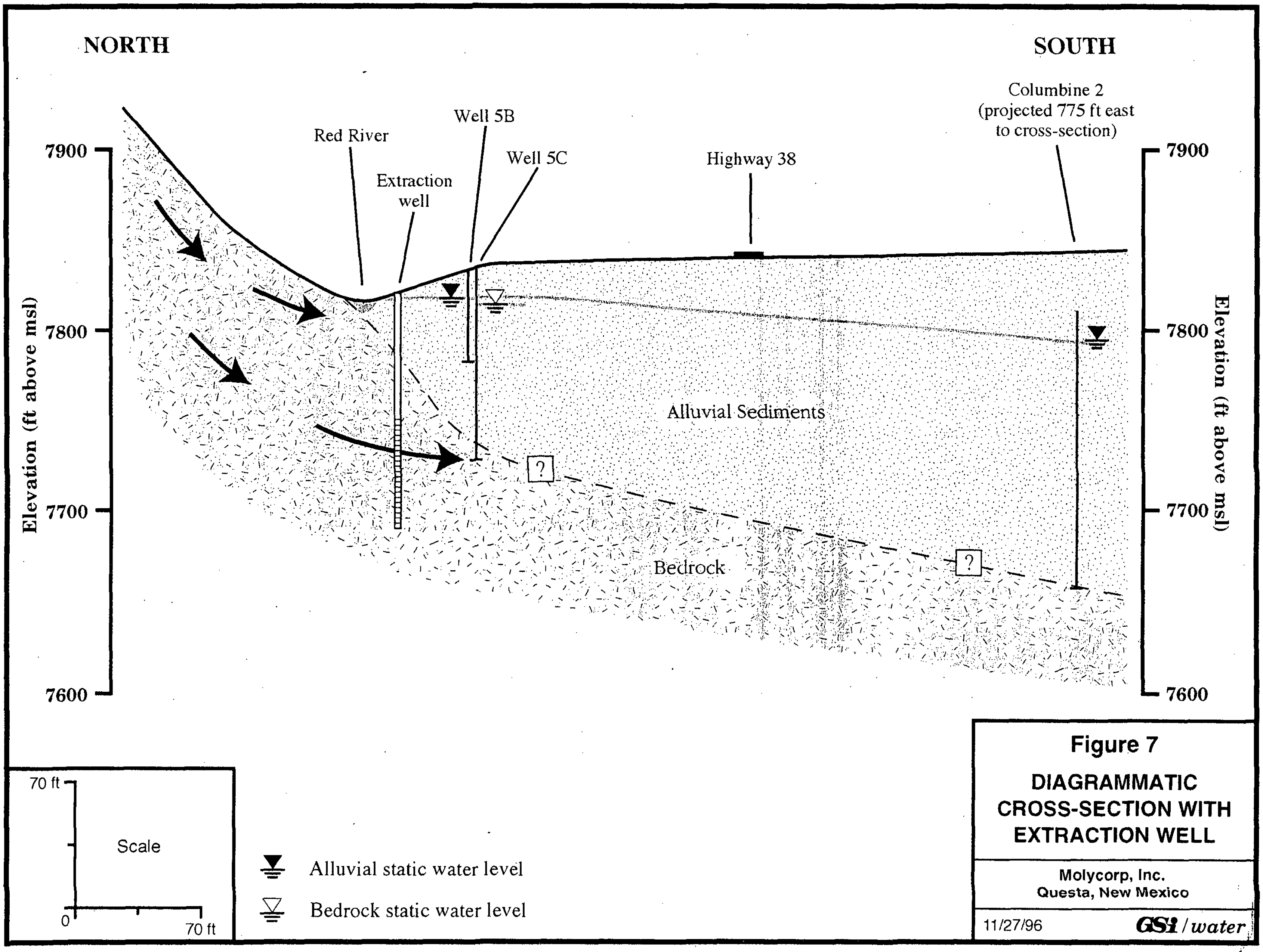


Figure 7

DIAGRAMMATIC CROSS-SECTION WITH EXTRACTION WELL

RECOMMENDATIONS

To help eliminate spring flow and to reduce or eliminate the aluminum hydroxide precipitate in the Cabin Springs area, we recommend the following:

- Conduct a falling head test and a short term pumping test in observation well P-5c. During the test monitor water levels in nearby observation wells and measure water quality and temperature at the springs, in the river, and in the wells.

- Review available data on the details of the bedrock geology and structure within and around the Cabin Springs area.

- Design and install ground water extraction wells into the bedrock aquifer. The locations, design, and spacing will depend in part on the characterization of the bedrock aquifer.

- Design a pumping system for the extraction wells that will allow their combined influence to effectively intercept the acidic source(s) of water before it enters the springs or river. The system would also be designed to minimize adverse impacts to the local hydrologic system.

Appendix A

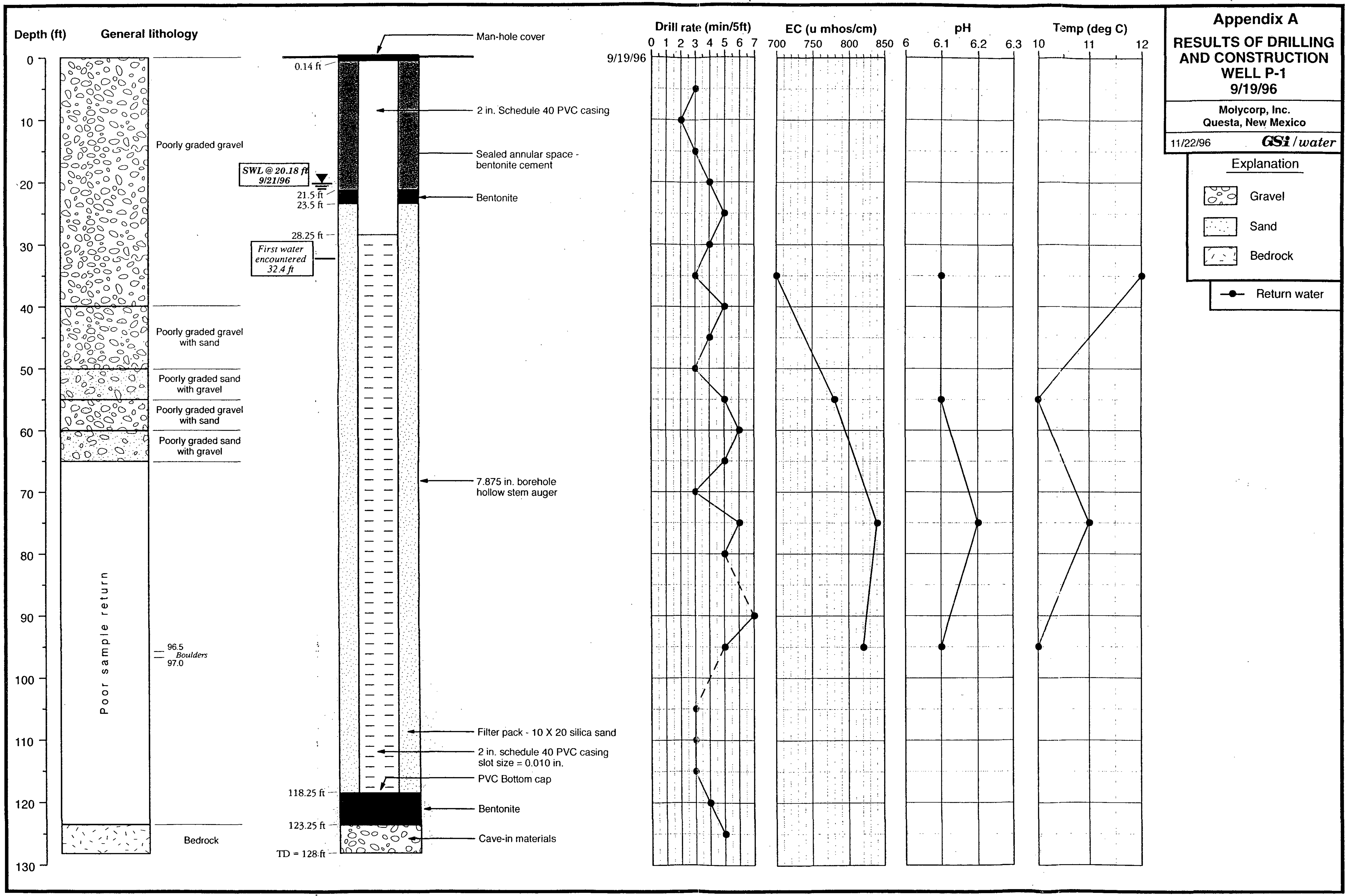
Drilling Logs and Well Construction Records

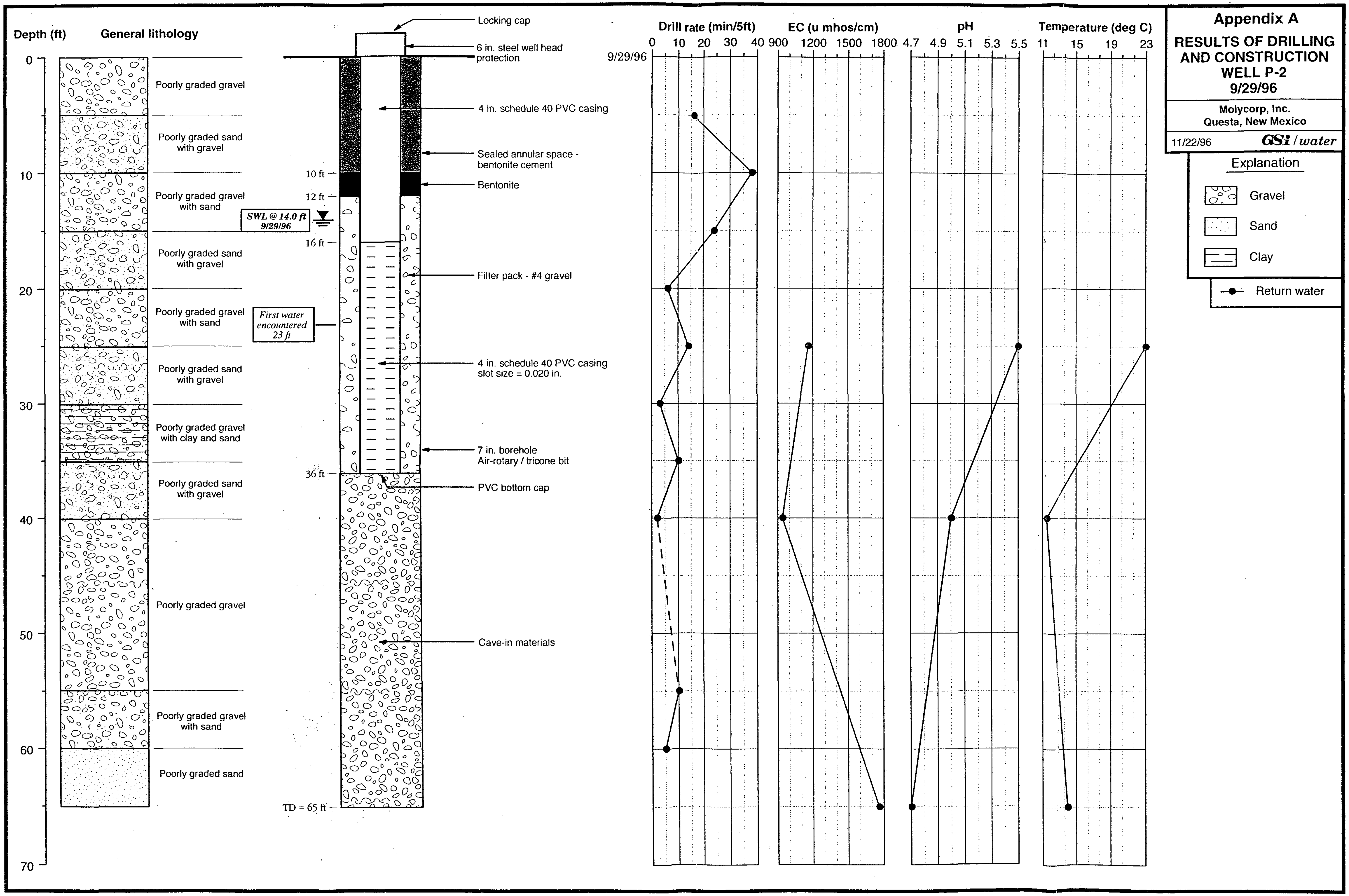
Appendix A

RESULTS OF DRILLING AND CONSTRUCTION WELL P-1
9/19/96

Molycorp, Inc.
Questa, New Mexico

11/22/96 GSi / water





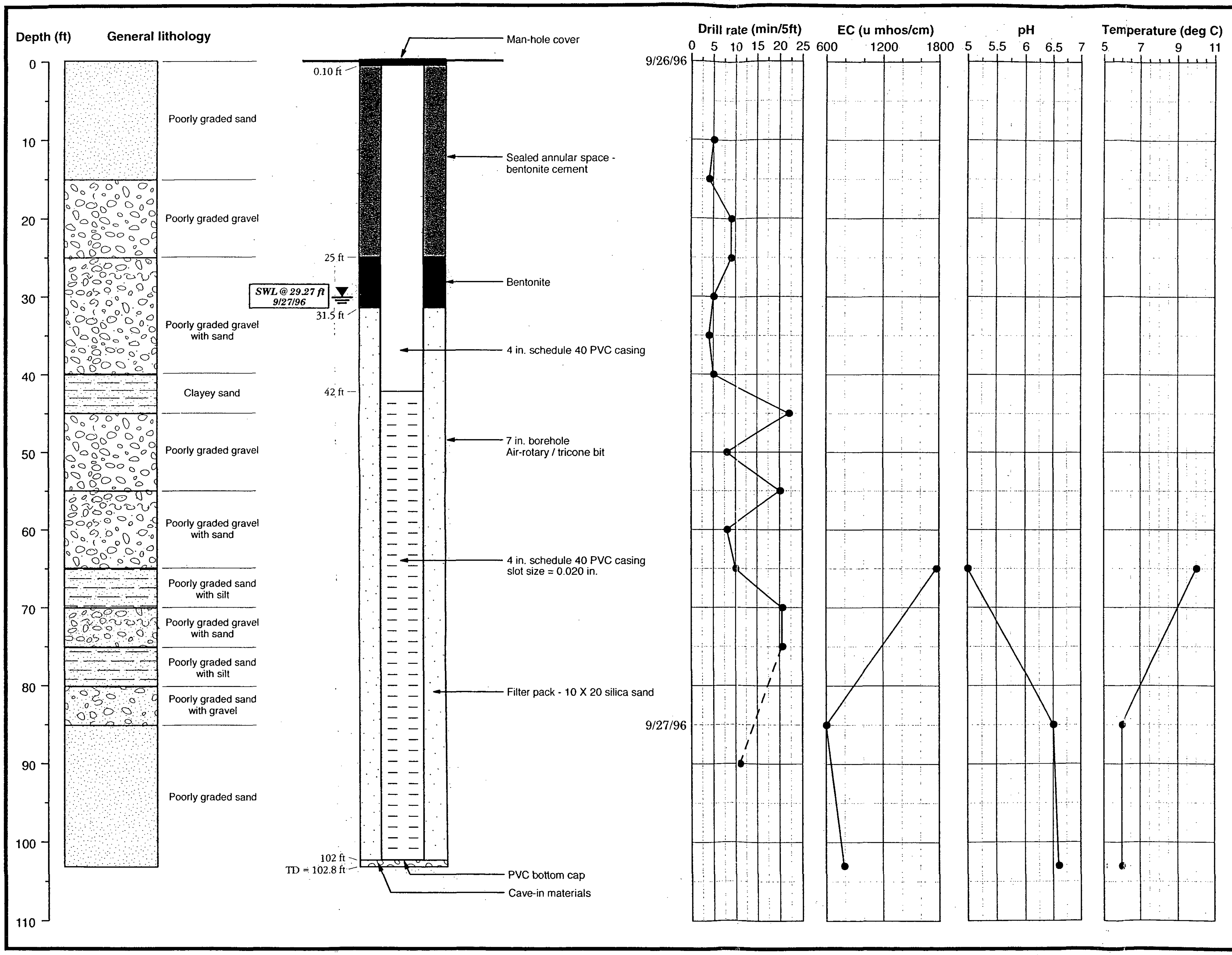
Appendix A
RESULTS OF DRILLING AND CONSTRUCTION WELL P-2
9/29/96
Molycorp, Inc.
Questa, New Mexico
11/22/96
GSi / water
Explanation
Gravel
Sand
Clay
Return water
Depth (ft)
General lithology
0
10
20
30
40
50
60
70
Poorly graded gravel
Poorly graded sand with gravel
Poorly graded gravel with sand
Poorly graded sand with gravel
Poorly graded gravel with sand
Poorly graded sand with gravel
Poorly graded gravel with clay and sand
Poorly graded sand with gravel
Poorly graded gravel
Poorly graded gravel with sand
Poorly graded sand
Locking cap
6 in. steel well head protection
4 in. schedule 40 PVC casing
Sealed annular space - bentonite cement
Bentonite
Filter pack - #4 gravel
4 in. schedule 40 PVC casing slot size = 0.020 in.
7 in. borehole Air-rotary / tricone bit
PVC bottom cap
Cave-in materials
10 ft
12 ft
16 ft
36 ft
TD = 65 ft
SWL @ 14.0 ft 9/29/96
First water encountered 23 ft
Drill rate (min/5ft)
0 10 20 30 40
EC (u mhos/cm)
900 1200 1500 1800
pH
4.7 4.9 5.1 5.3 5.5
Temperature (deg C)
11 15 19 23
9/29/96

Appendix A

RESULTS OF DRILLING AND CONSTRUCTION WELL P-3
9/26 - 9/27/96

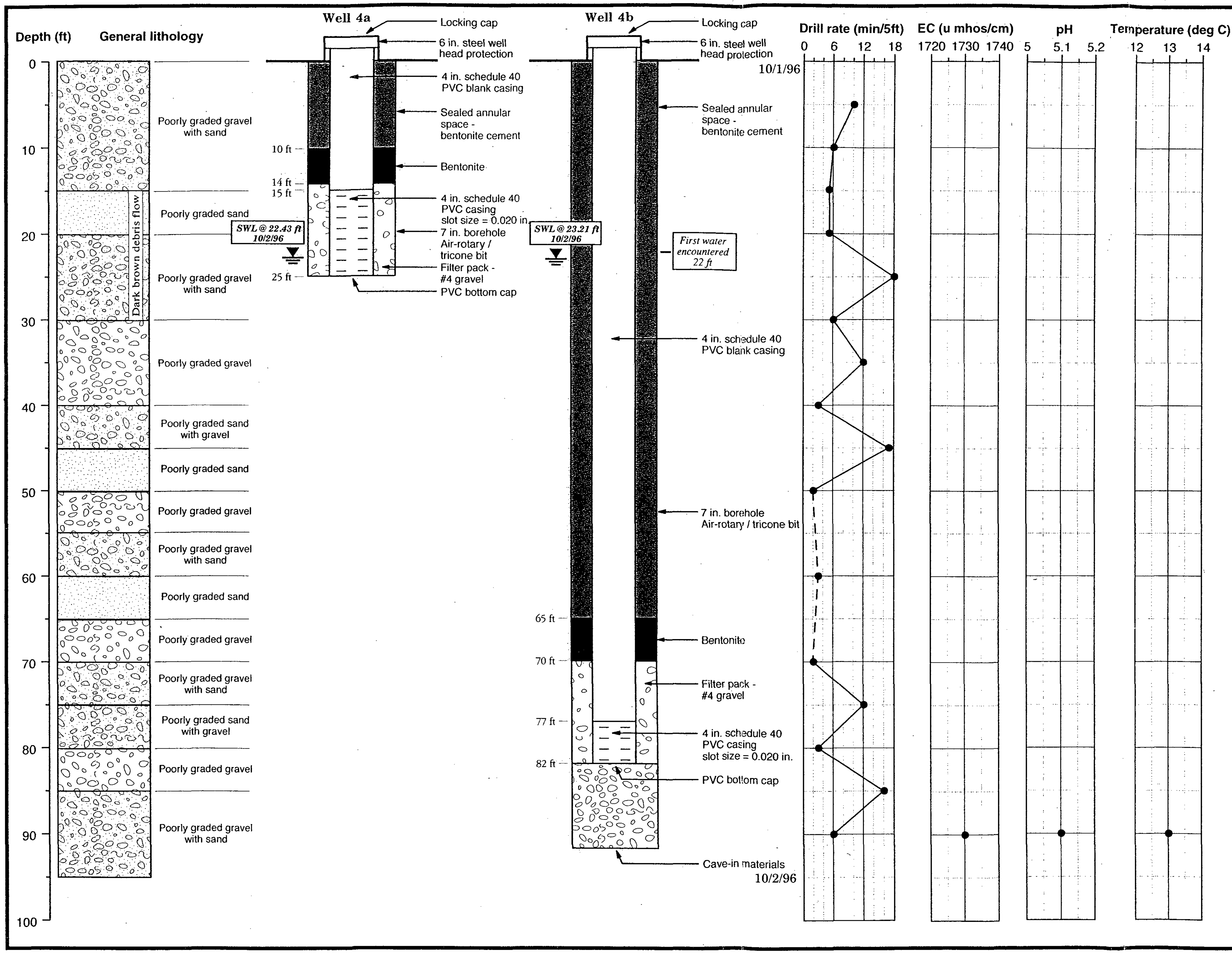
Molycorp, Inc.
Questa, New Mexico

11/22/96 *GSi/water*



Explanation

- Gravel
- Sand
- Clay / silt
- Return water



Appendix A

RESULTS OF DRILLING AND CONSTRUCTION WELL P-4a & 4b 10/1 - 10/2/96

Molycorp, Inc.
Questa, New Mexico

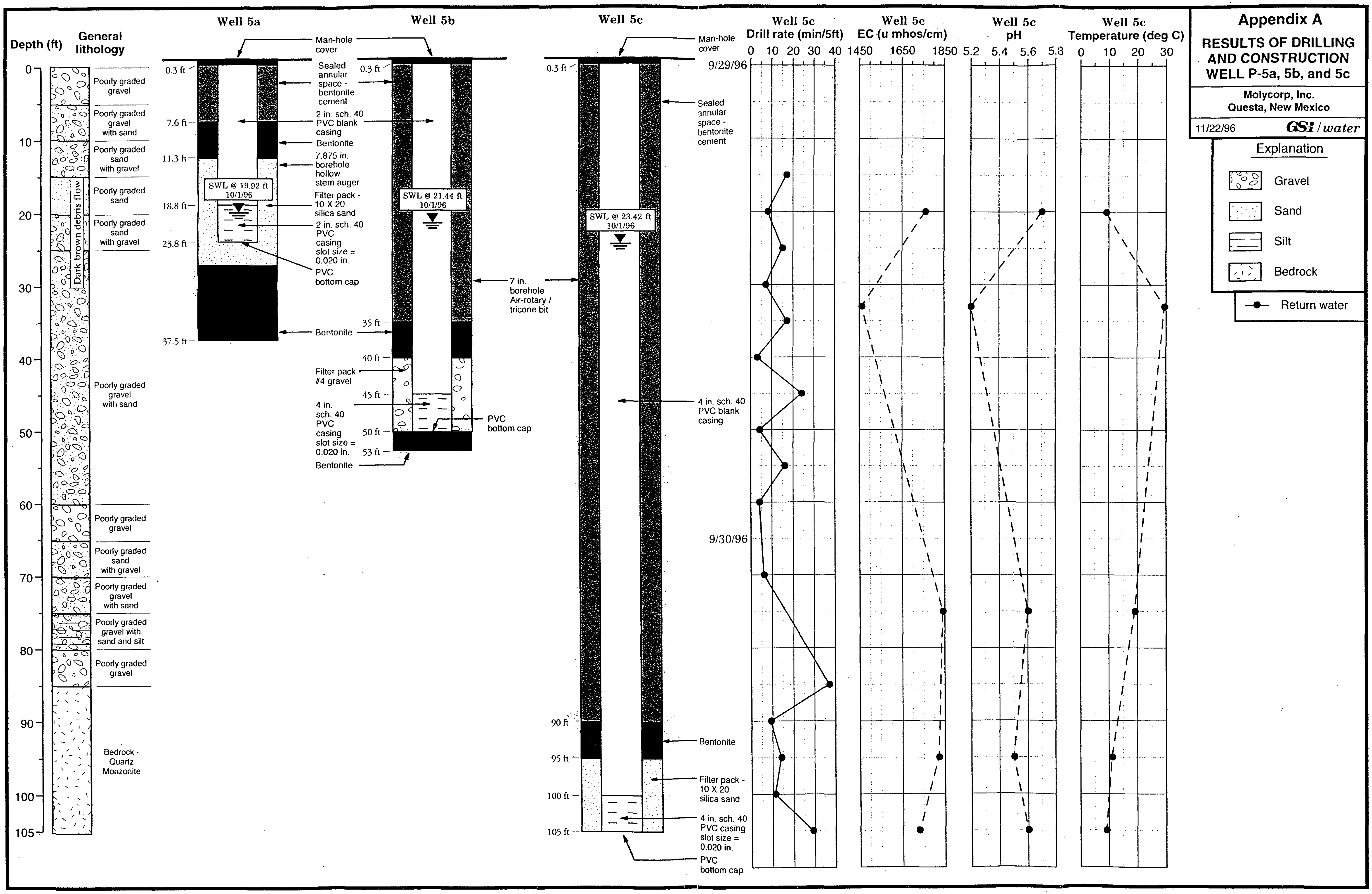
11/21/96 GSi/water

Explanation

Gravel

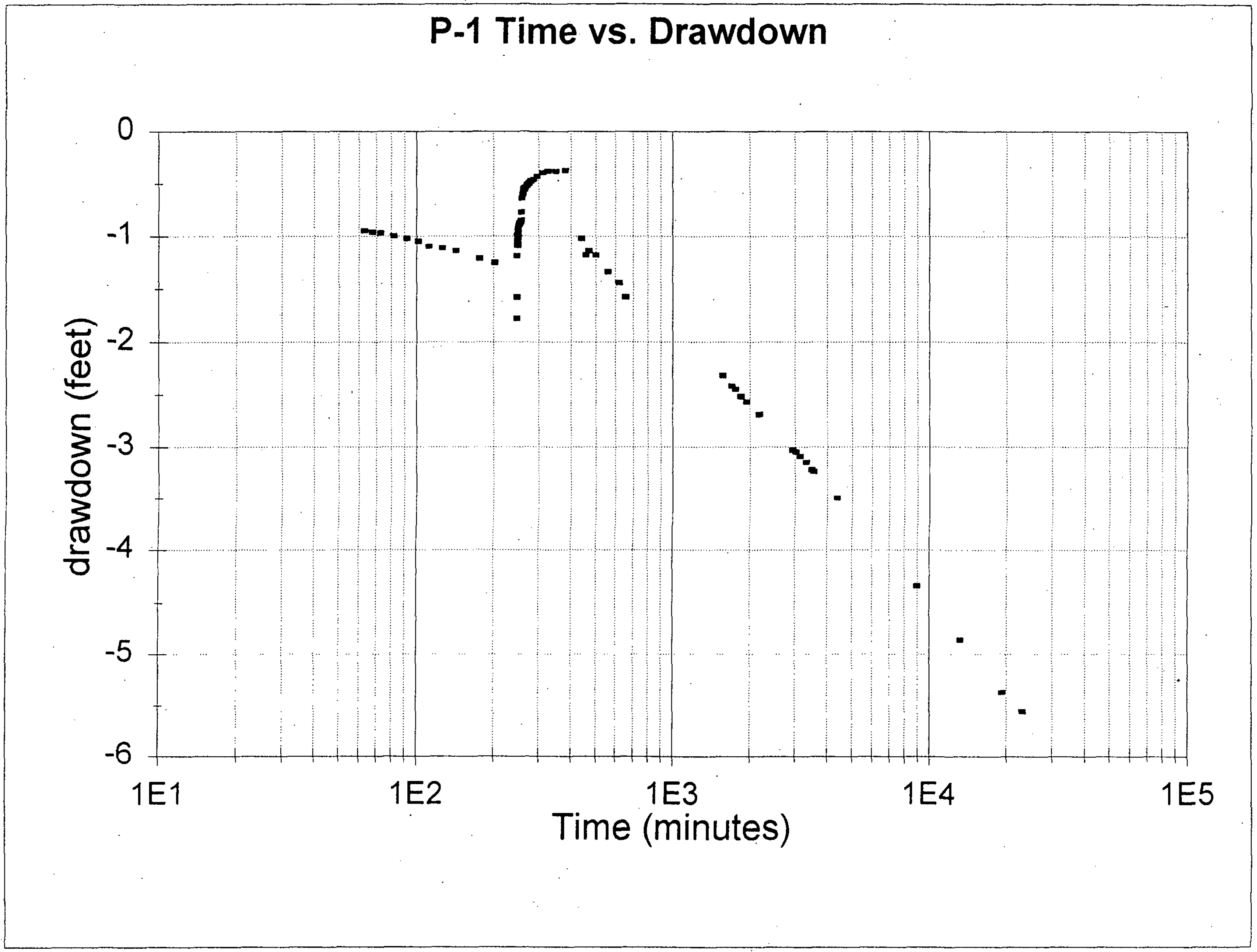
Sand

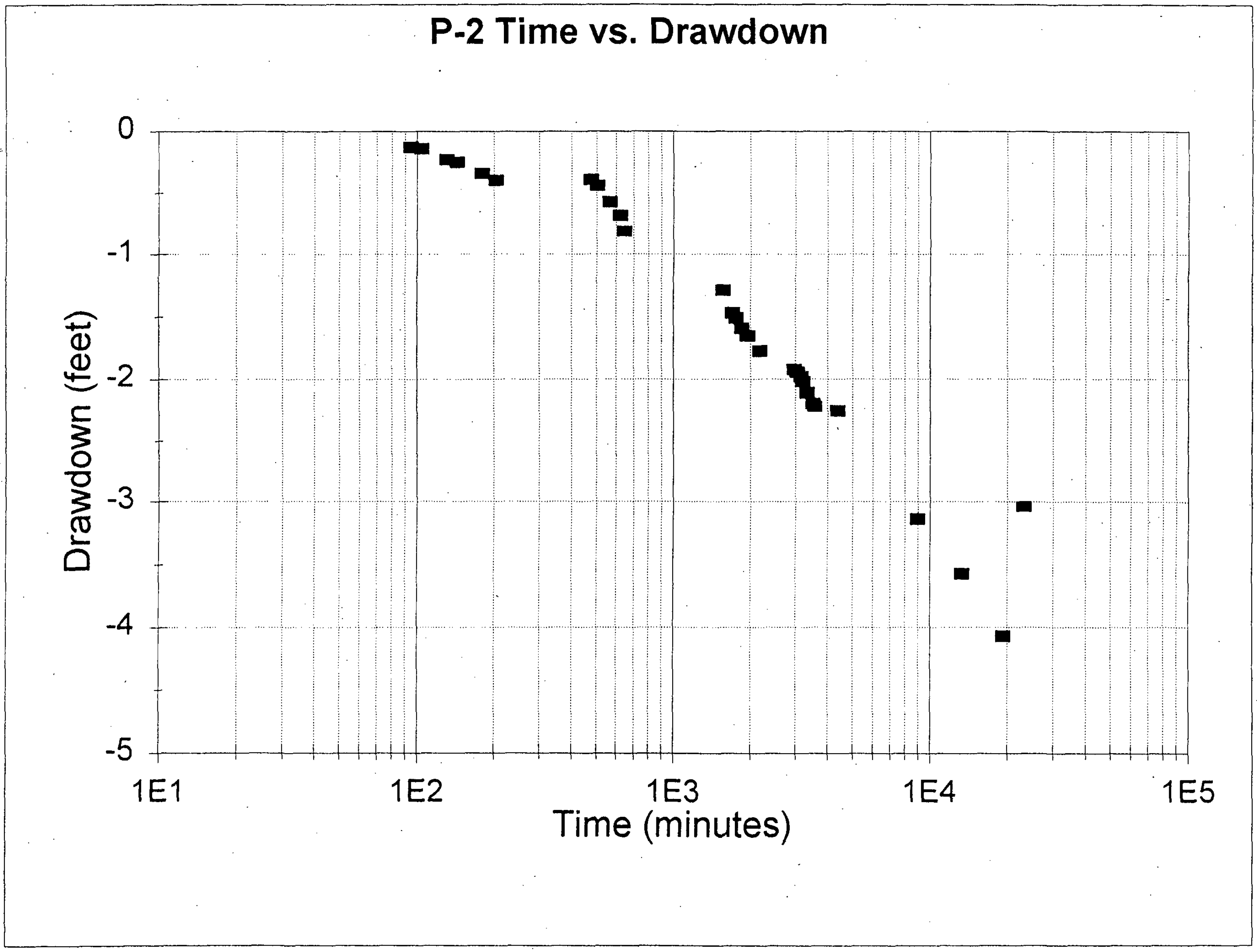
Return water



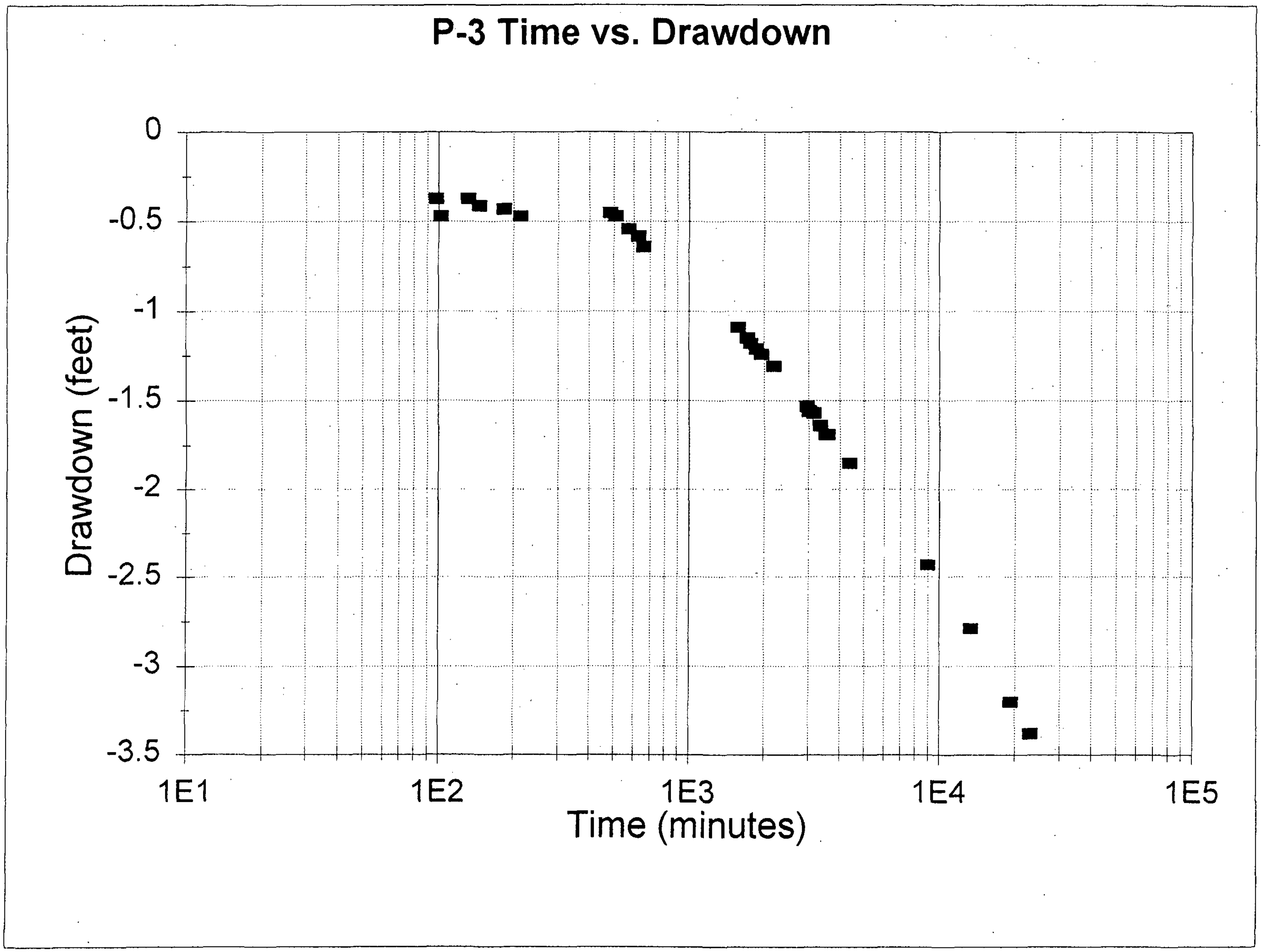
Appendix A
RESULTS OF DRILLING AND CONSTRUCTION WELL P-5a, 5b, and 5c
Molycorp, Inc.
Questa, New Mexico
11/22/96
GSi/water
Explanation
Gravel
Sand
Silt
Bedrock
Return water
Depth (ft)
General lithology
Poorly graded gravel
Poorly graded gravel with sand
Poorly graded sand with gravel
Poorly graded sand
Poorly graded sand with gravel
Dark brown debris flow
Poorly graded gravel with sand
Poorly graded gravel
Poorly graded sand with gravel
Poorly graded gravel with sand
Poorly graded gravel with sand and silt
Poorly graded gravel
Bedrock - Quartz Monzonite
Well 5a
Well 5b
Well 5c
Man-hole cover
Sealed annular space - bentonite cement
2 in. sch. 40 PVC blank casing
Bentonite
7.875 in. borehole hollow stem auger
Filter pack - 10 X 20 silica sand
2 in. sch. 40 PVC casing slot size = 0.020 in.
PVC bottom cap
SWL @ 19.92 ft 10/1/96
SWL @ 21.44 ft 10/1/96
SWL @ 23.42 ft 10/1/96
0.3 ft
7.6 ft
11.3 ft
18.8 ft
23.8 ft
37.5 ft
35 ft
40 ft
45 ft
50 ft
53 ft
Filter pack #4 gravel
4 in. sch. 40 PVC casing slot size = 0.020 in.
7 in. borehole Air-rotary / tricone bit
4 in. sch. 40 PVC blank casing
90 ft
95 ft
100 ft
105 ft
Filter pack - 10 X 20 silica sand
4 in. sch. 40 PVC casing slot size = 0.020 in.
9/29/96
9/30/96
Well 5c Drill rate (min/5ft)
Well 5c EC (u mhos/cm)
Well 5c pH
Well 5c Temperature (deg C)

000855


P-1 Time vs. Drawdown
0
-1
-2
-3
-4
-5
-6
drawdown (feet)
1E1
1E2
1E3
1E4
1E5
Time (minutes)

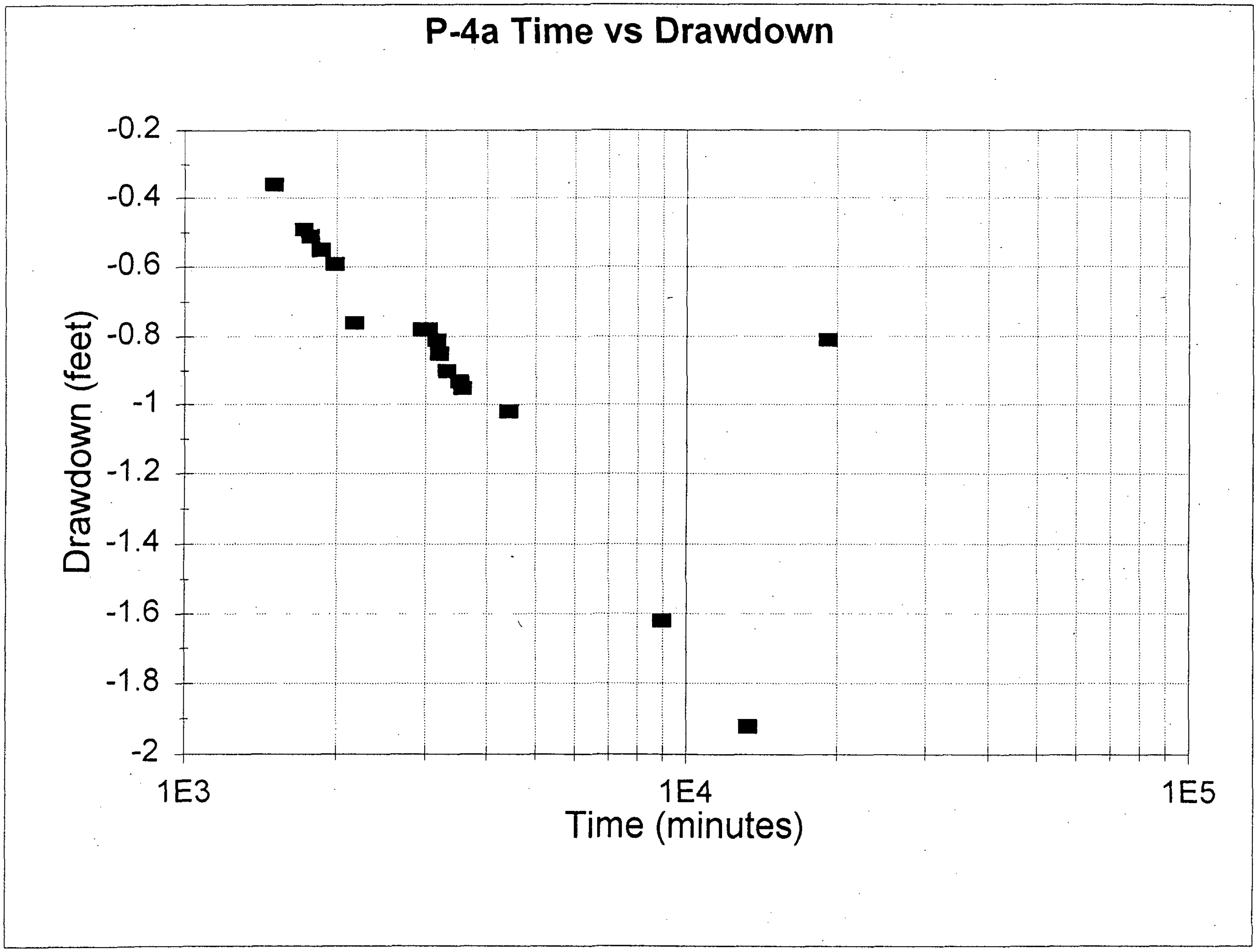

P-2 Time vs. Drawdown
0
-1
-2
-3
-4
-5
Drawdown (feet)
1E1
1E2
1E3
1E4
1E5
Time (minutes)

000857

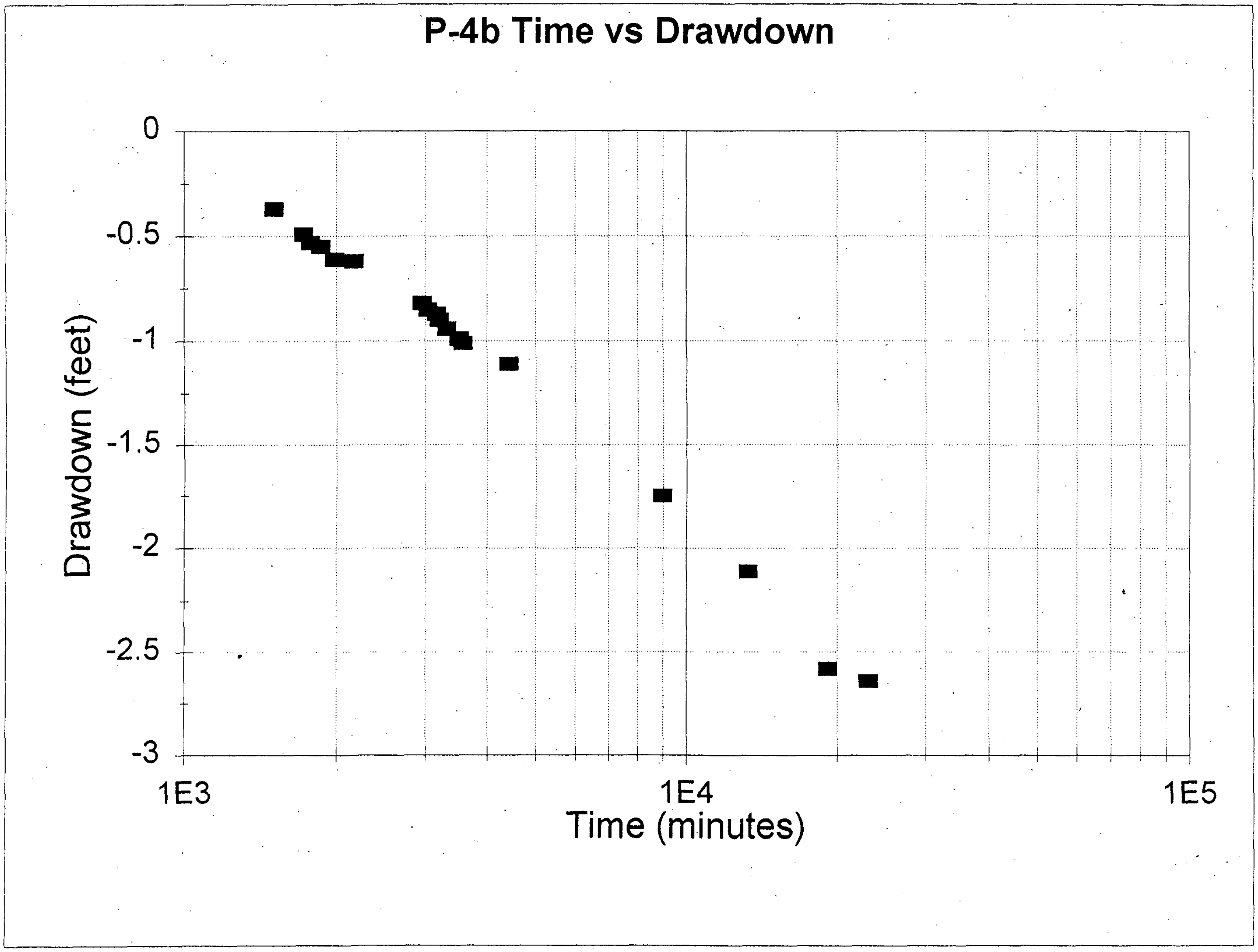


P-3 Time vs. Drawdown
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
Drawdown (feet)
1E1
1E2
1E3
1E4
1E5
Time (minutes)

000858


P-4a Time vs Drawdown
Drawdown (feet)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
1E3
1E4
1E5
Time (minutes)

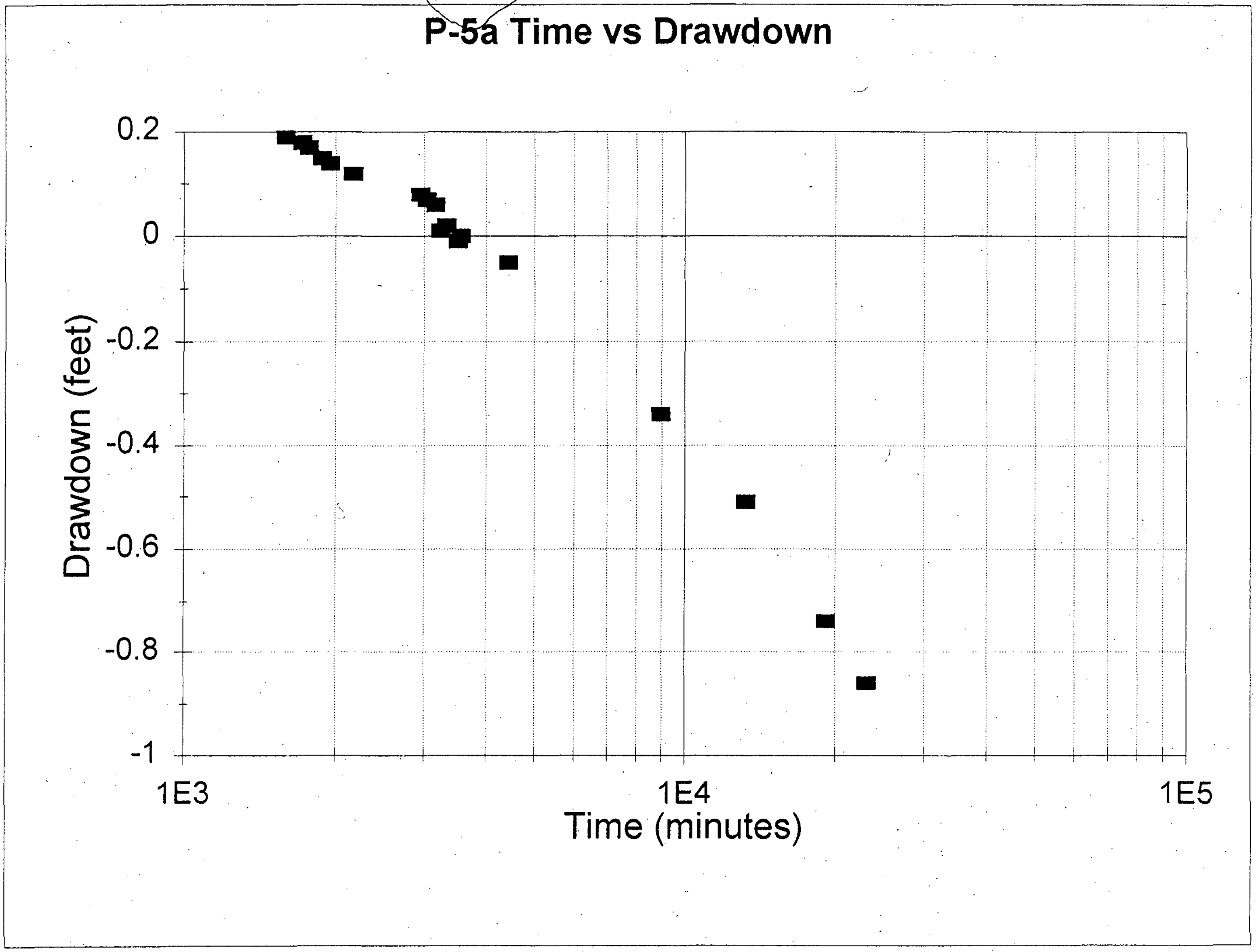
000859



P-4b Time vs Drawdown
0
-0.5
-1
-1.5
-2
-2.5
-3
Drawdown (feet)
1E3
1E4
1E5
Time (minutes)

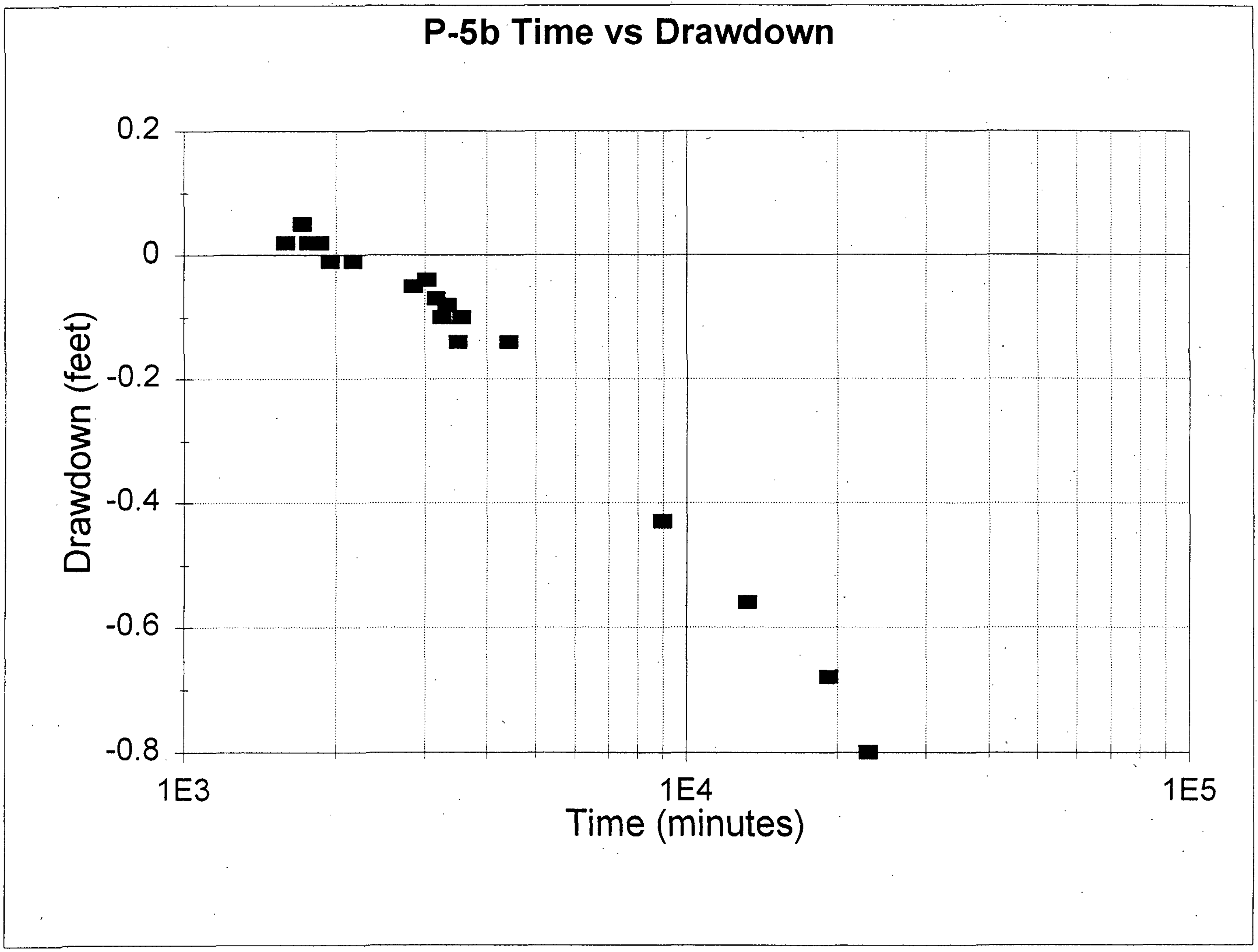
Appendix B

Water Level Data

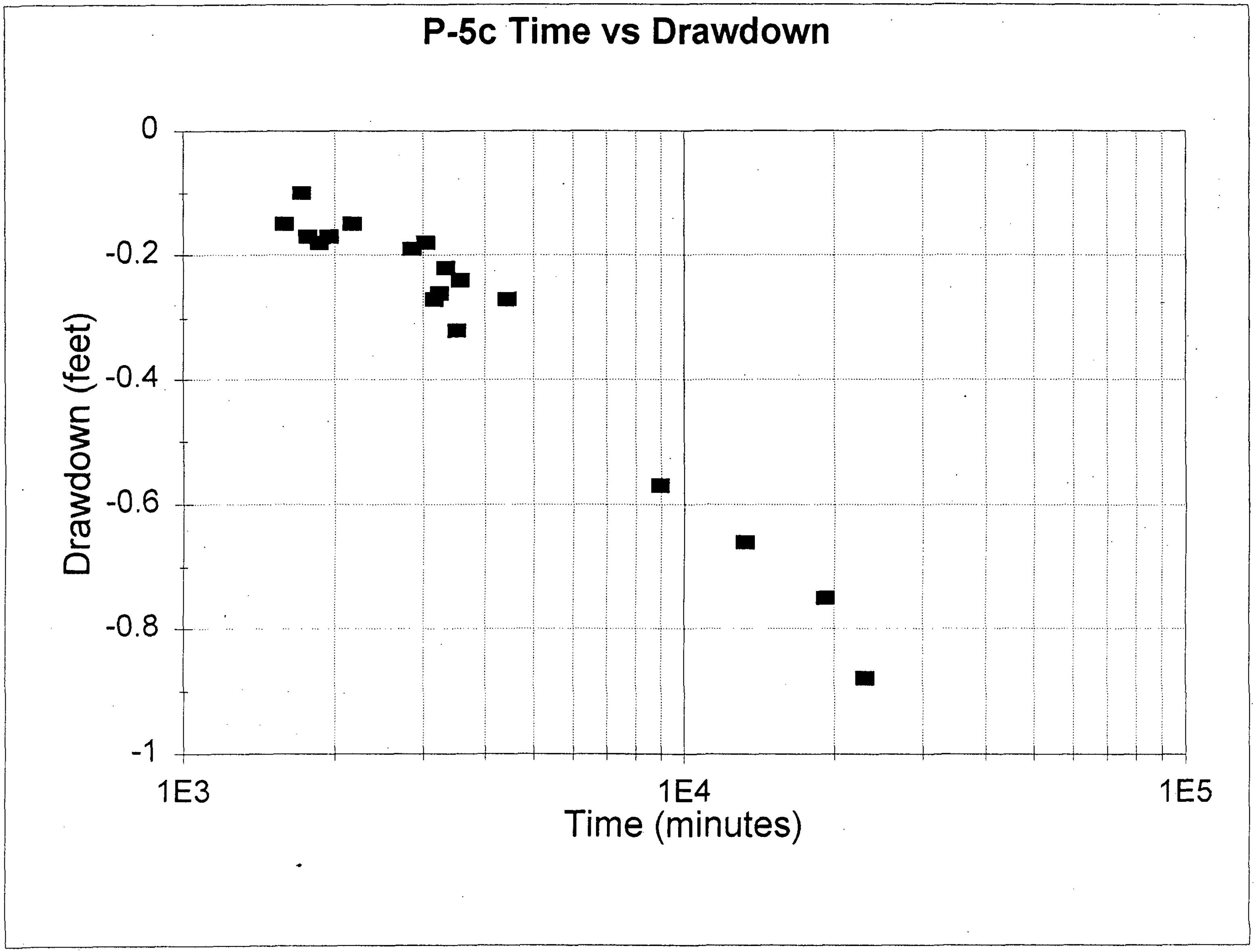


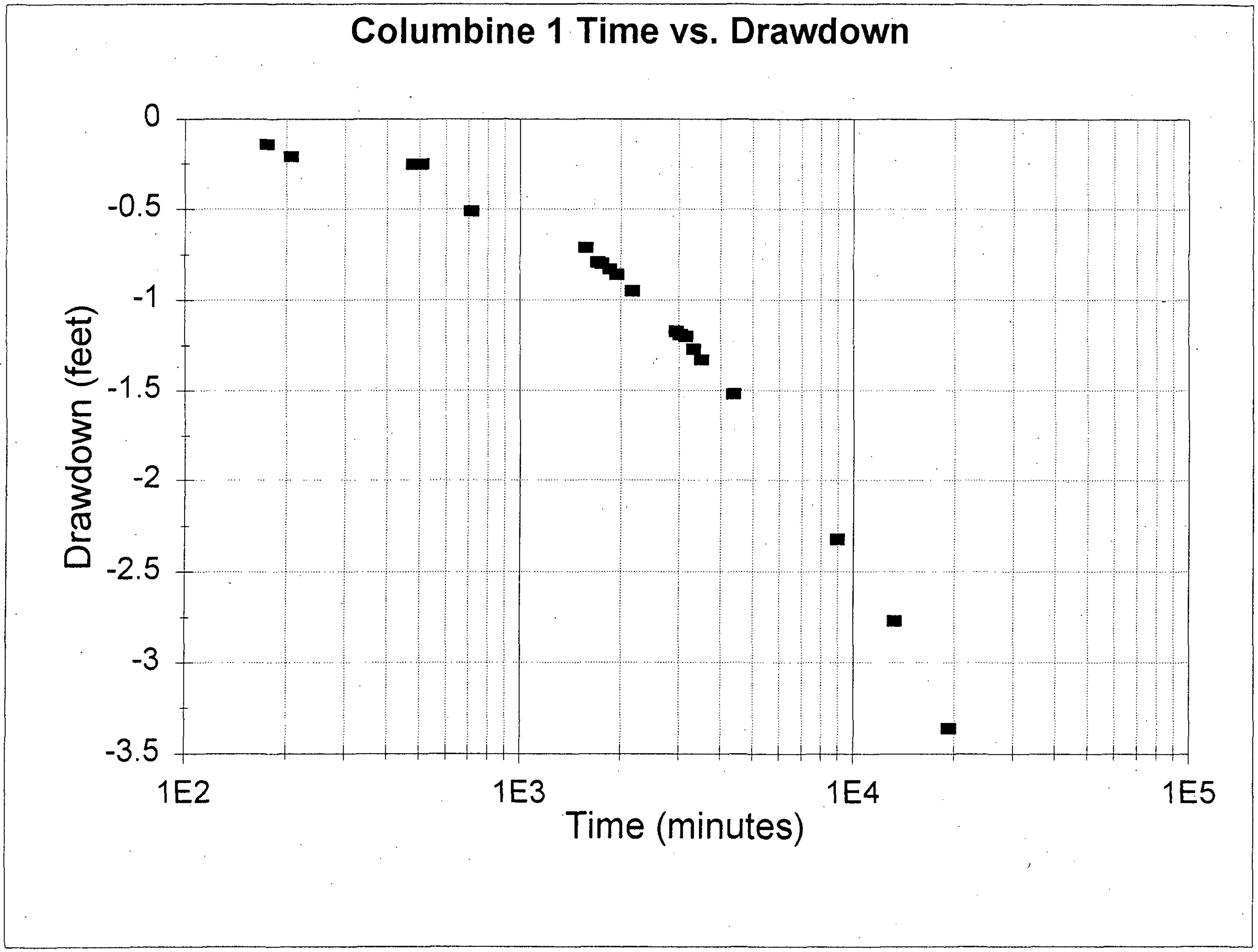
P-5a Time vs Drawdown
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Drawdown (feet)
1E3
1E4
1E5
Time (minutes)

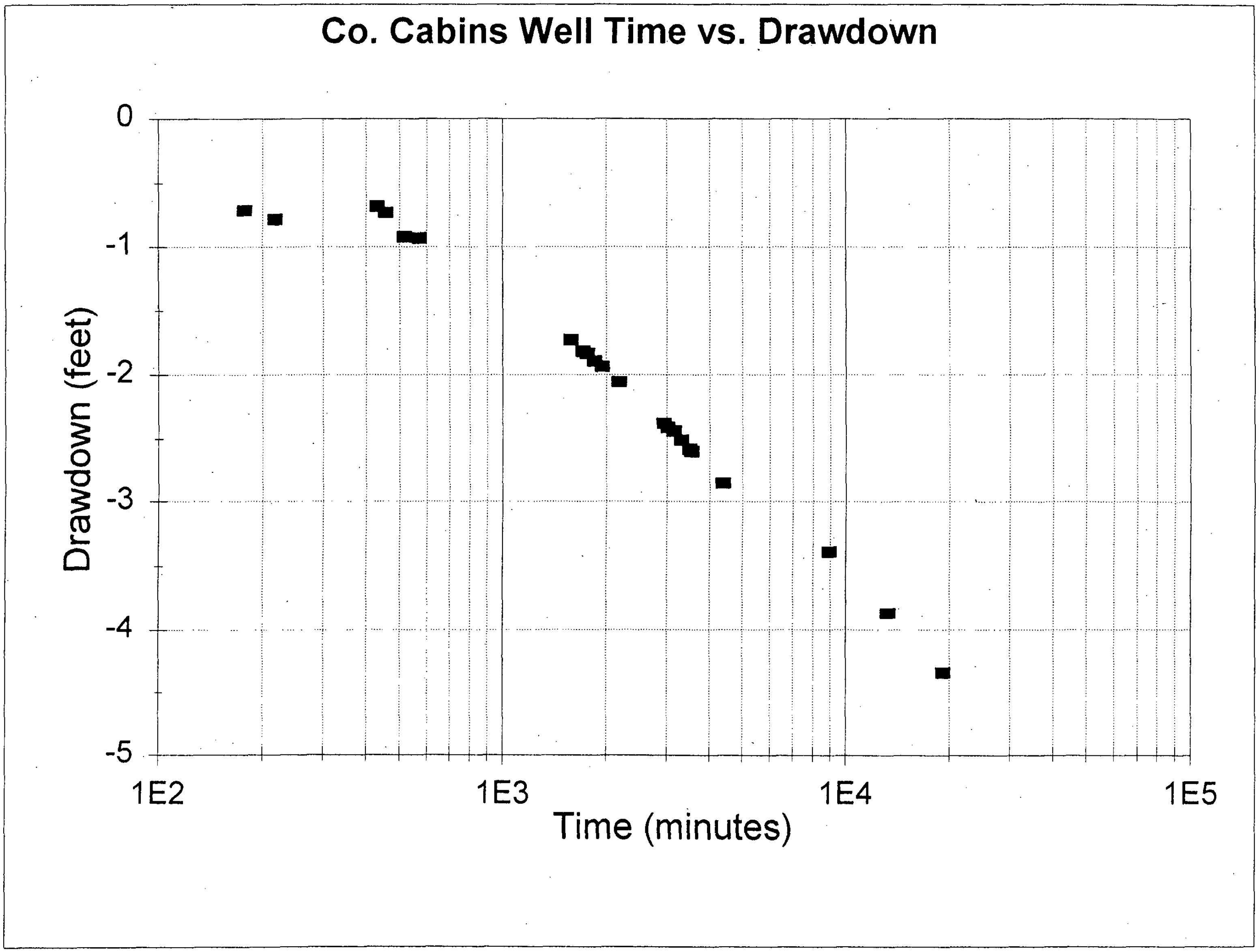
000862


P-5b Time vs Drawdown
0.2
0
-0.2
-0.4
-0.6
-0.8
Drawdown (feet)
1E3
1E4
1E5
Time (minutes)

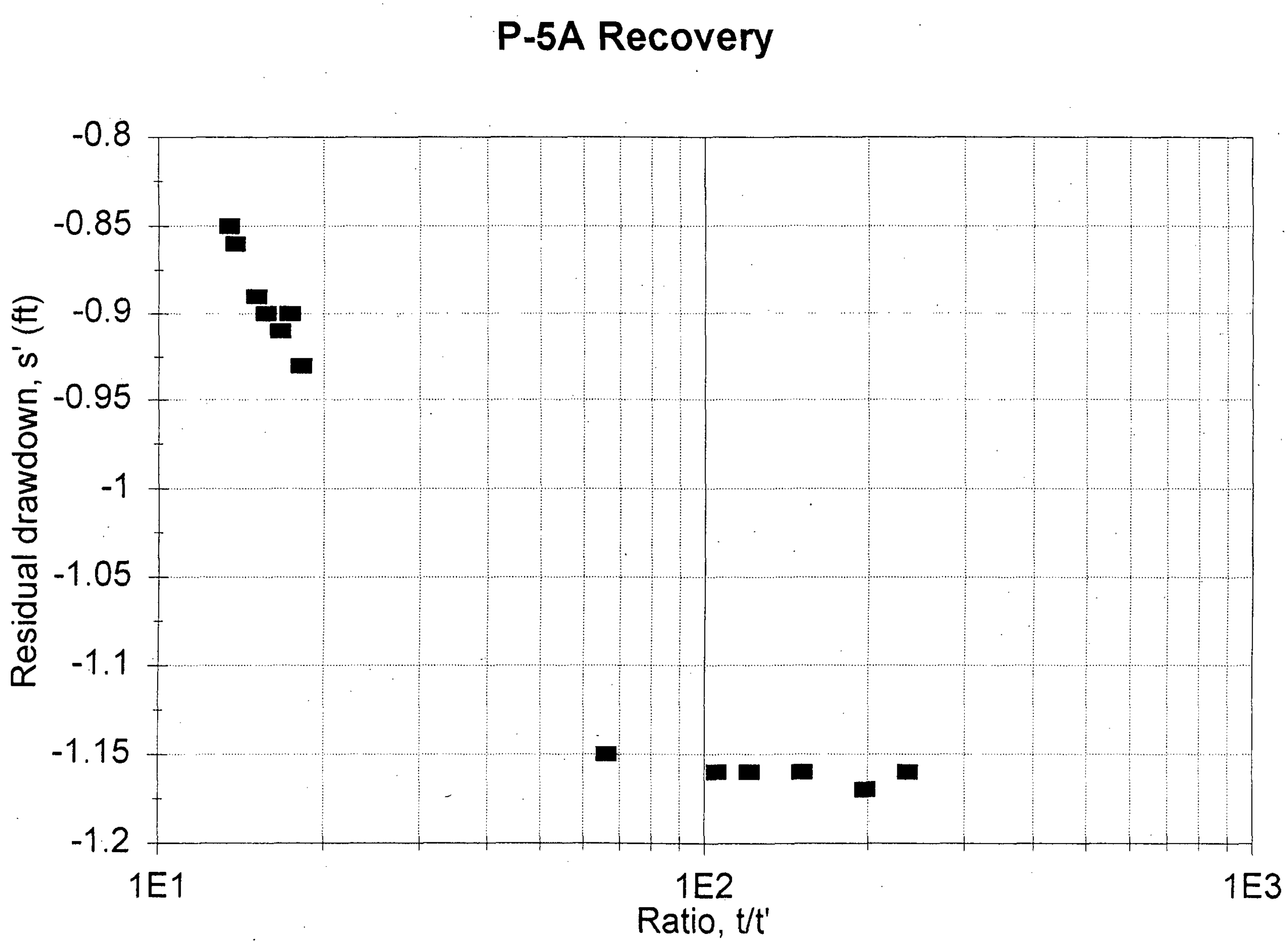
000863

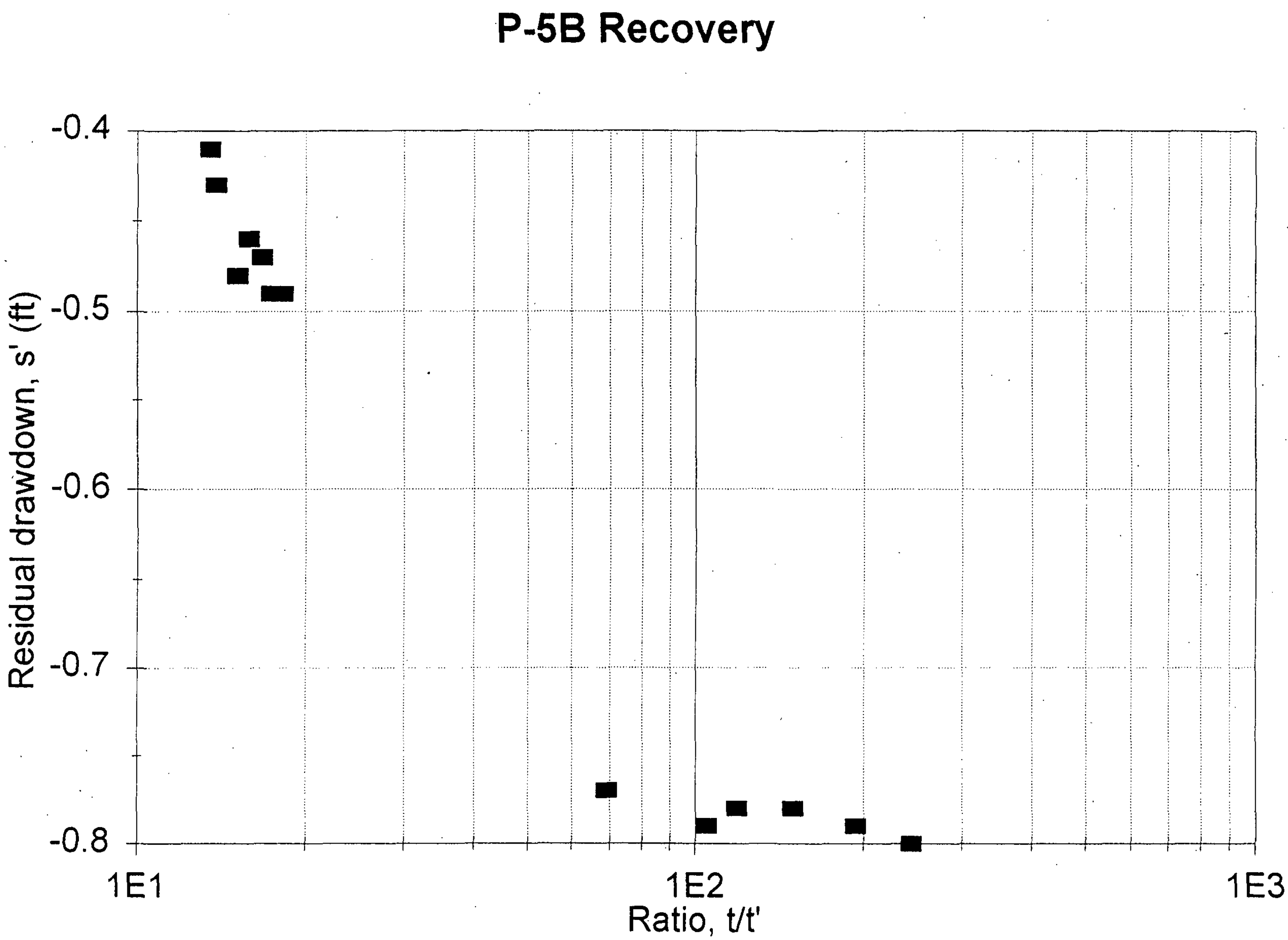

P-5c Time vs Drawdown
0
-0.2
-0.4
-0.6
-0.8
-1
Drawdown (feet)
1E3
1E4
1E5
Time (minutes)


Columbine 1 Time vs. Drawdown
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
Drawdown (feet)
1E2
1E3
1E4
1E5
Time (minutes)



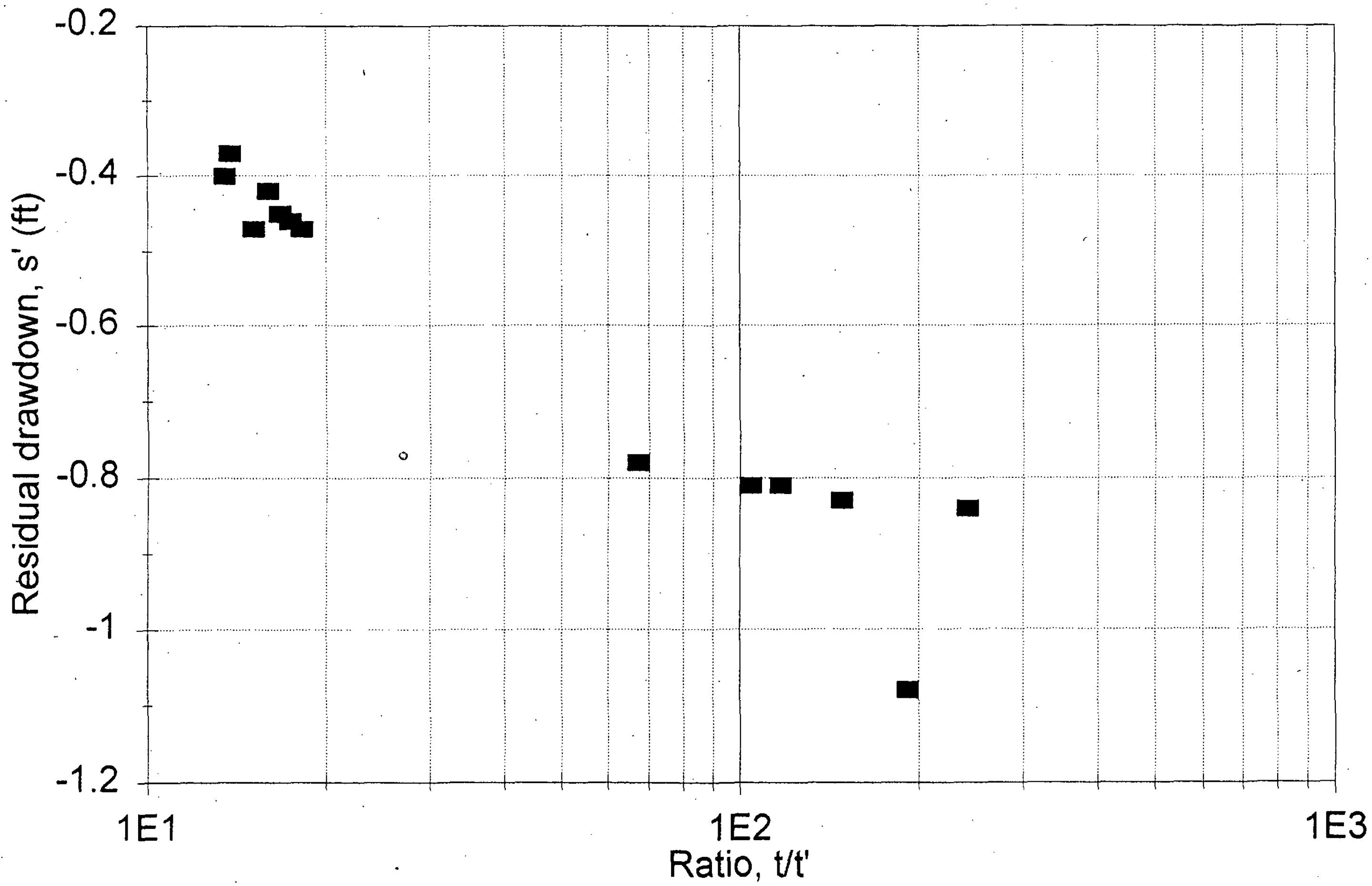
Co. Cabins Well Time vs. Drawdown
0
-1
-2
-3
-4
-5
Drawdown (feet)
1E2
1E3
1E4
1E5
Time (minutes)


P-5A Recovery
-0.8
-0.85
-0.9
-0.95
-1
-1.05
-1.1
-1.15
-1.2
Residual drawdown, s' (ft)
1E1
1E2
1E3
Ratio, t/t'

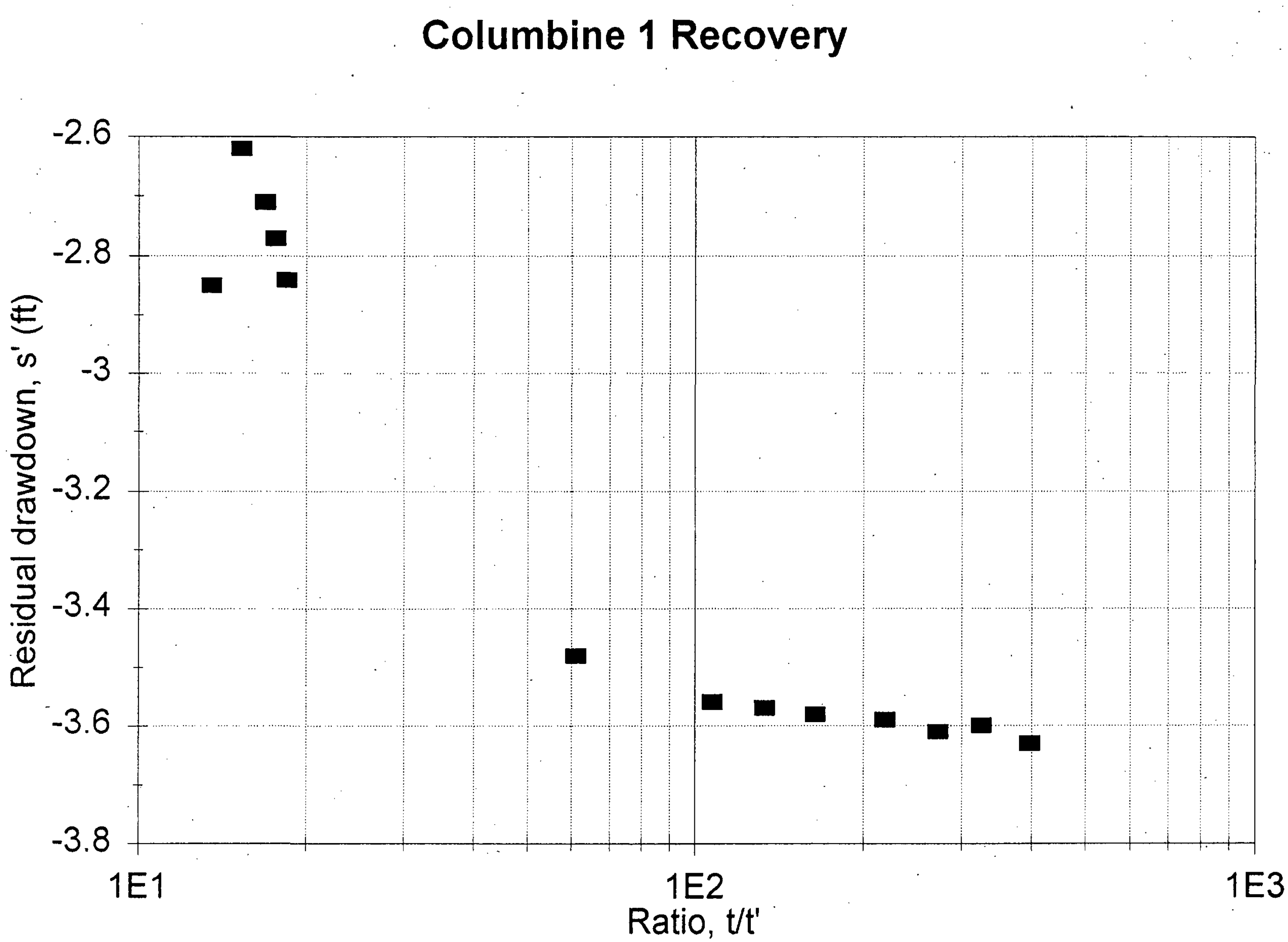

P-5B Recovery
Residual drawdown, s' (ft)
-0.4
-0.5
-0.6
-0.7
-0.8
1E1
1E2
1E3
Ratio, t/t'

000868

P-5C Recovery

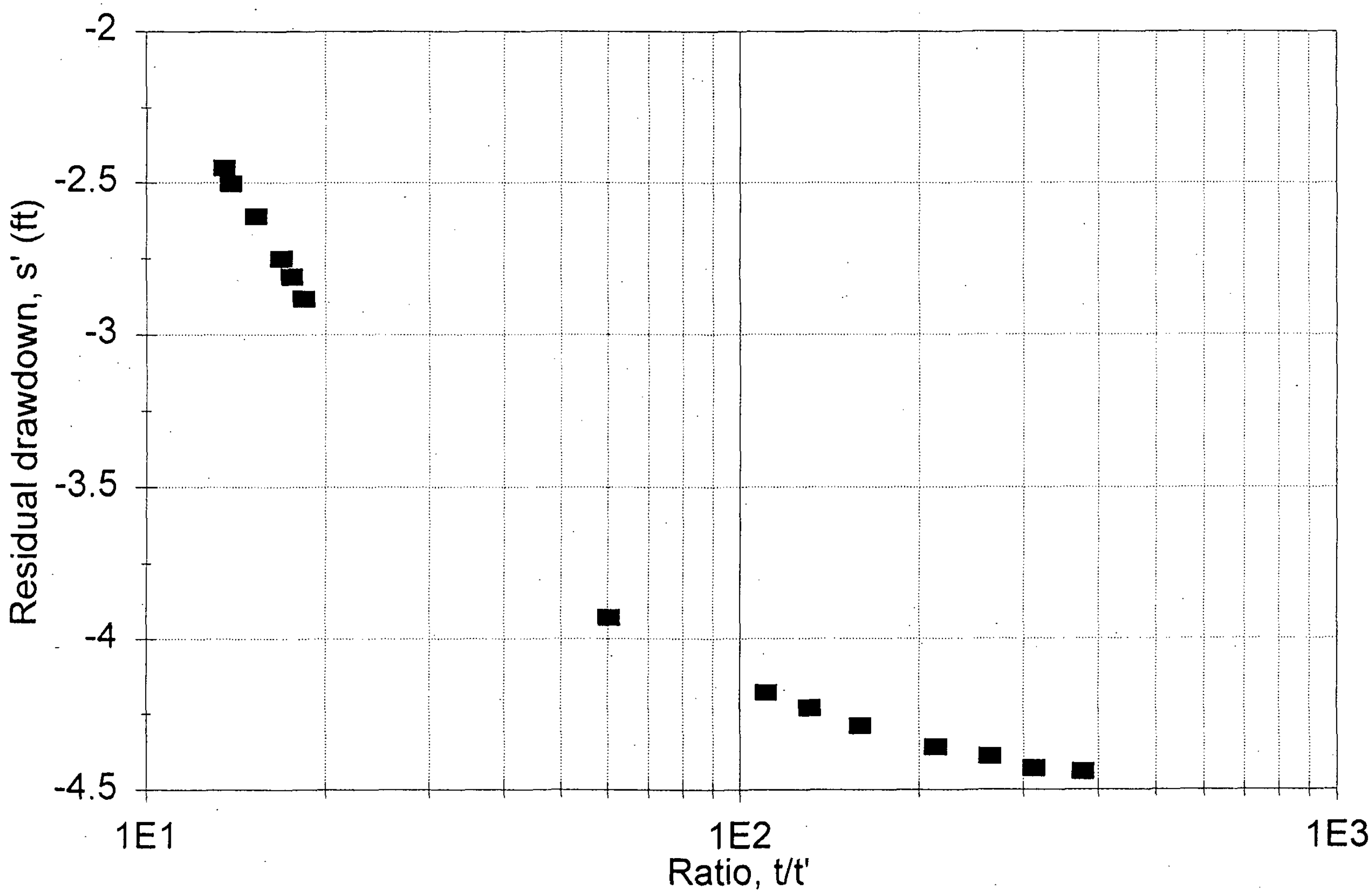


000869


Columbine 1 Recovery
-2.6
-2.8
-3
-3.2
-3.4
-3.6
-3.8
Residual drawdown, s' (ft)
1E1
1E2
1E3
Ratio, t/t'

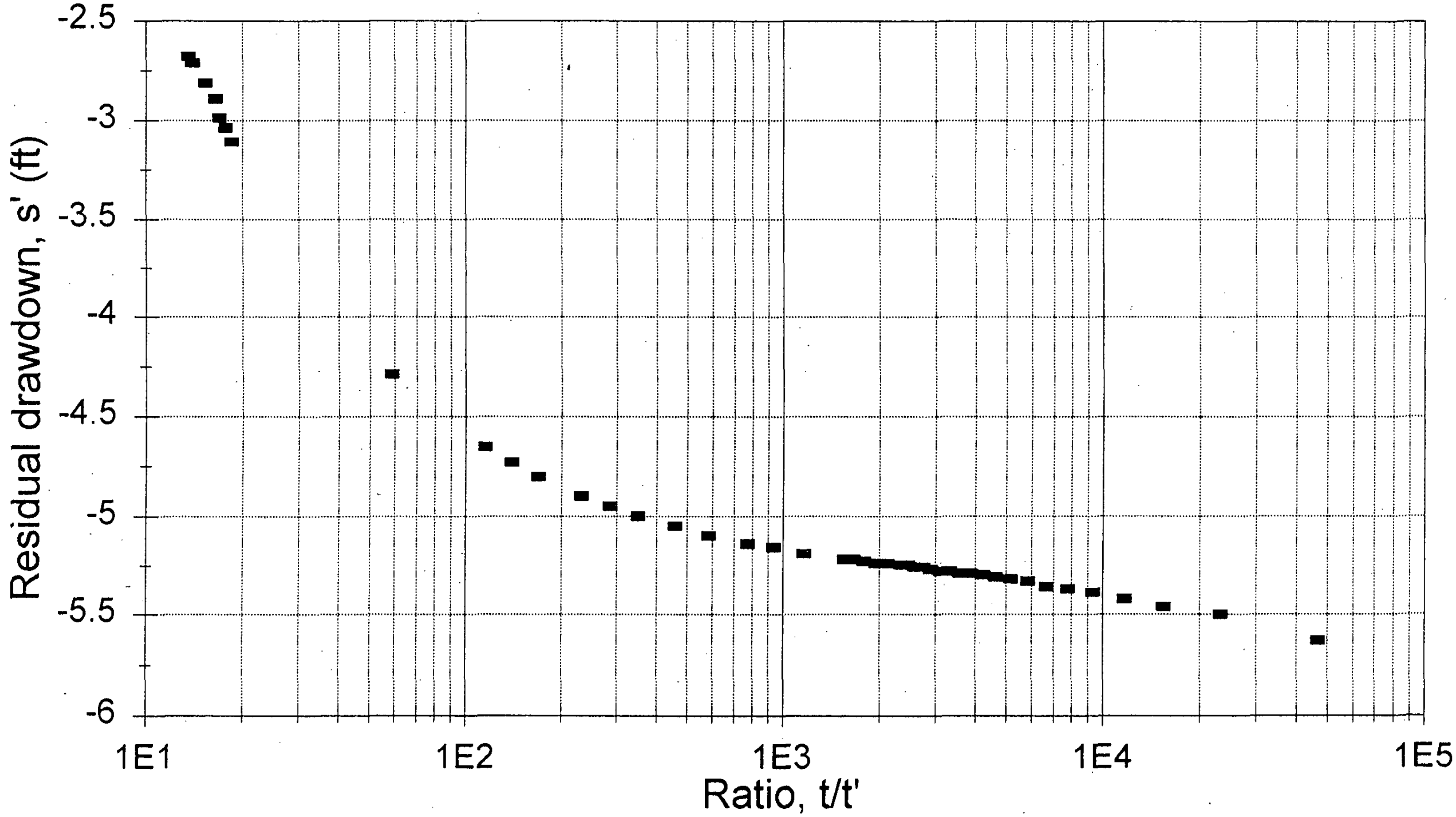
000870

Co. Cabin Well Recovery

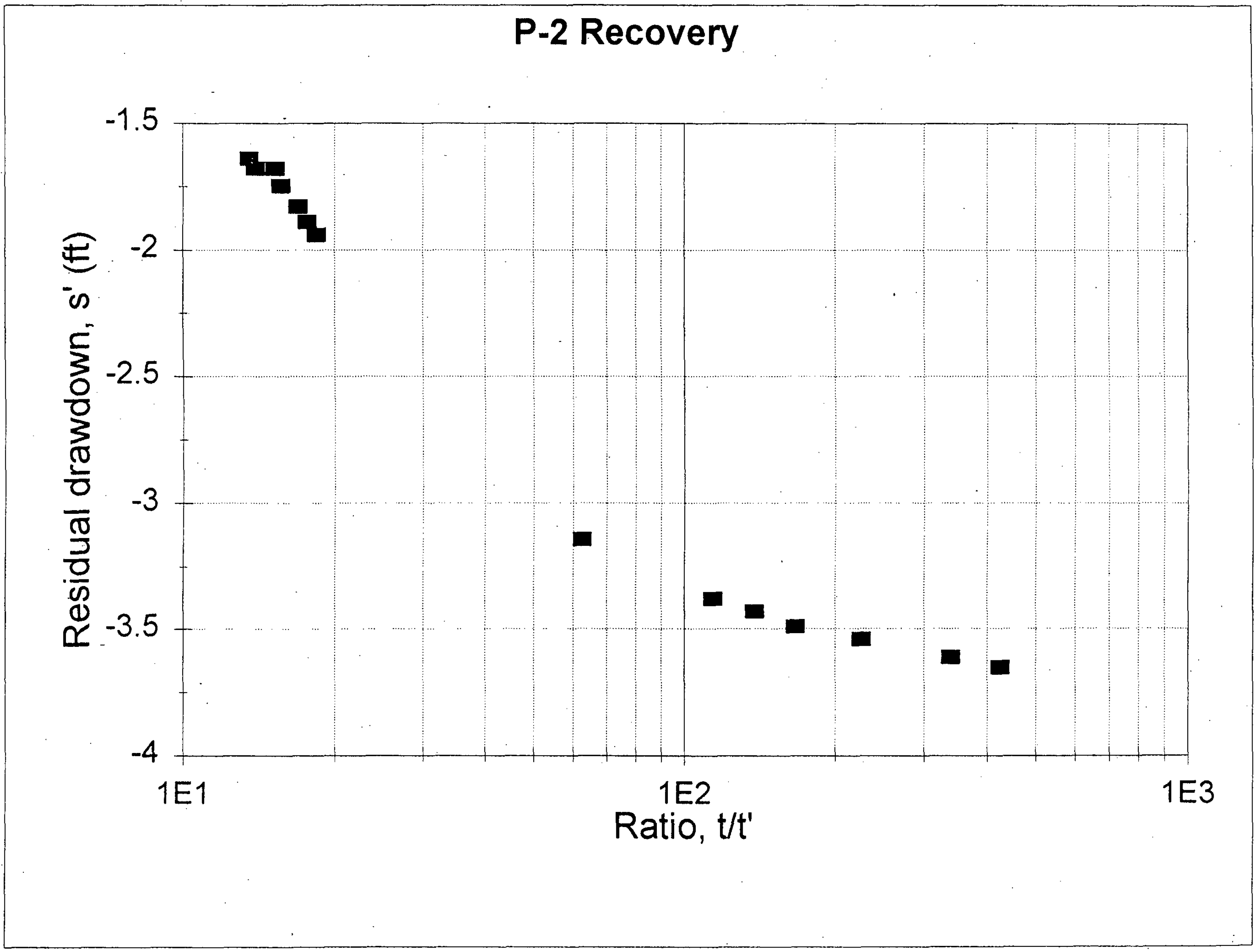


000871

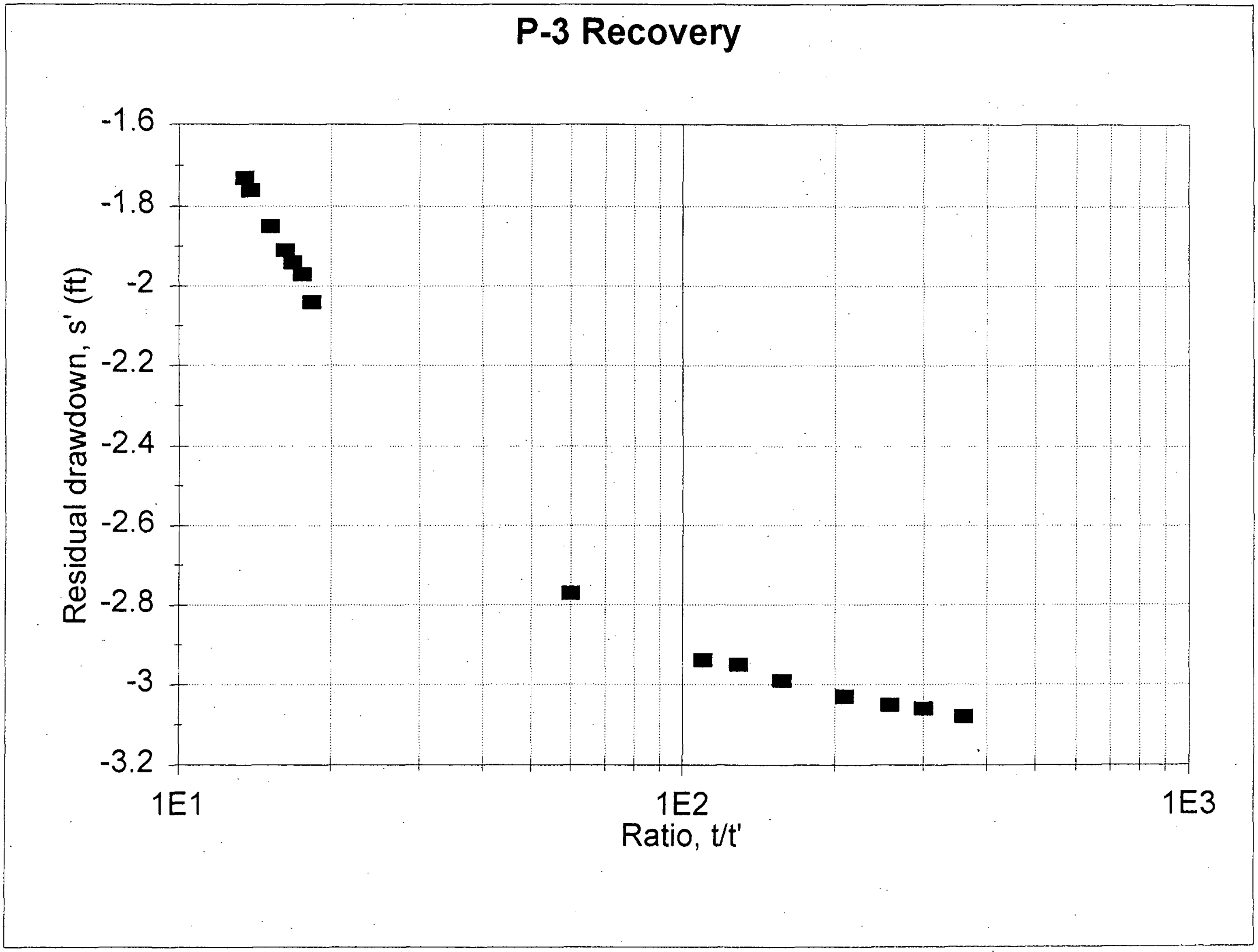
P-1 Recovery



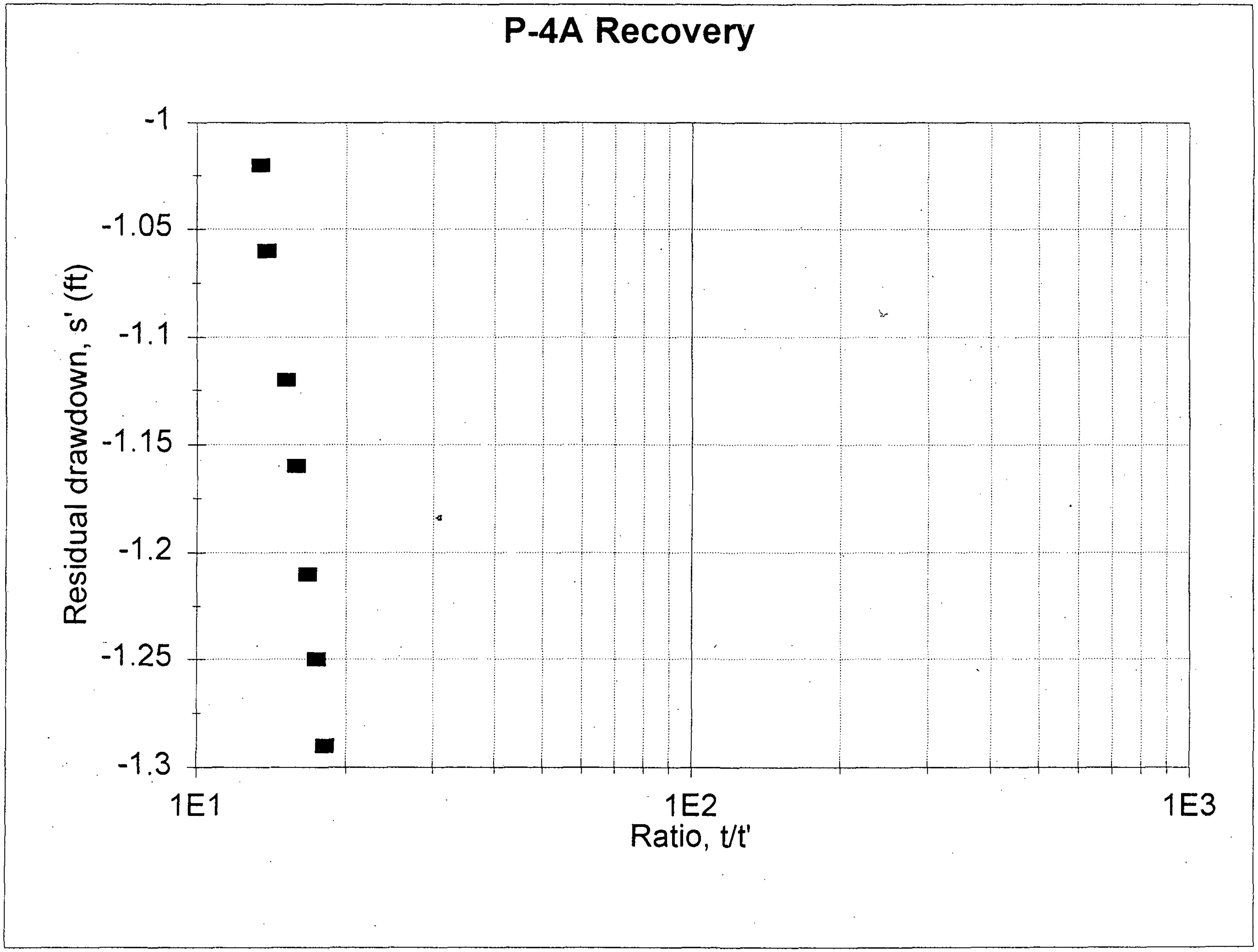
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Residual drawdown, s' (ft)
1E1
1E2
1E3
1E4
1E5
Ratio, t/t'

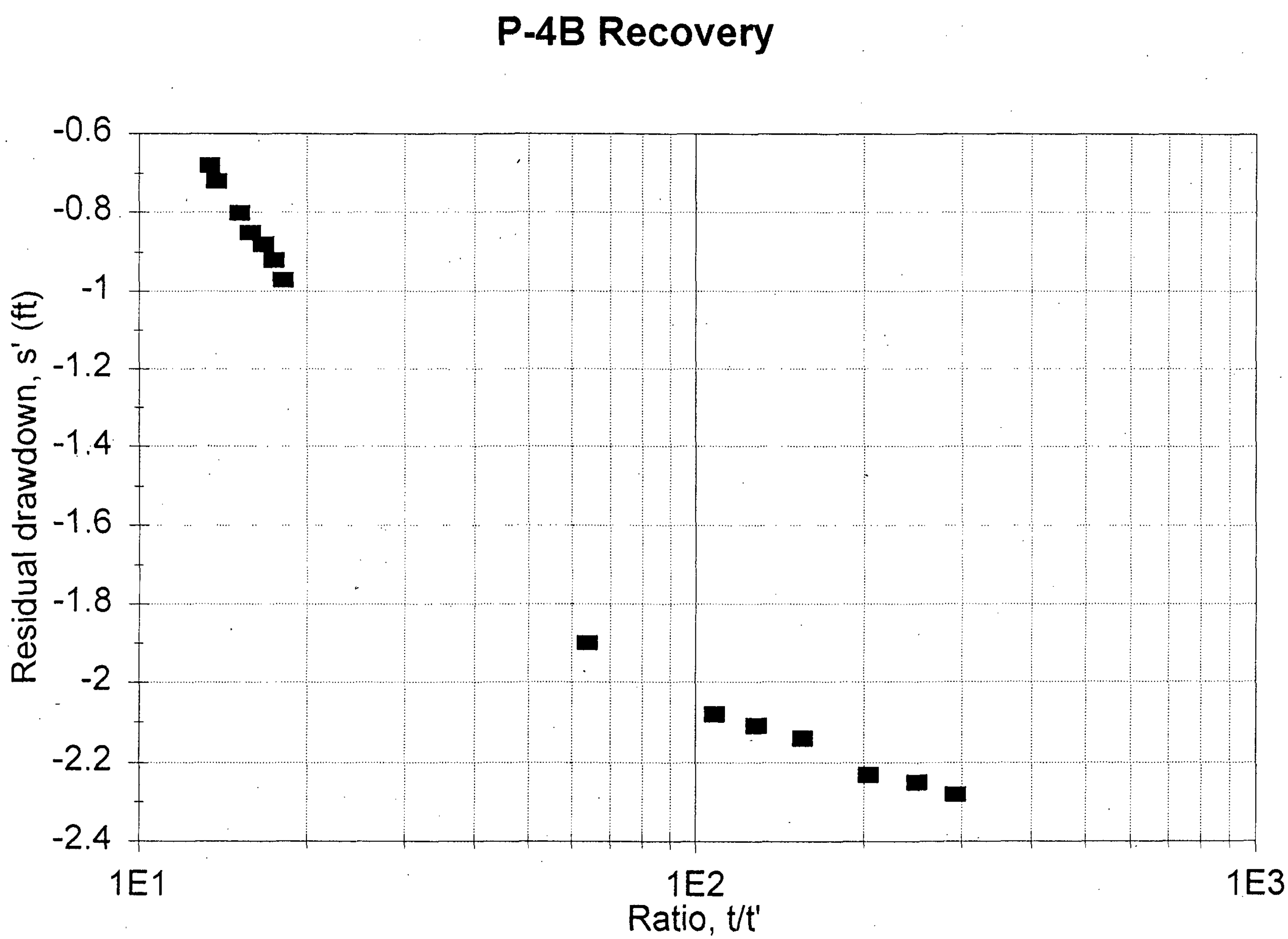

P-2 Recovery
Residual drawdown, s' (ft)
-1.5
-2
-2.5
-3
-3.5
-4
1E1
1E2
1E3
Ratio, t/t'

000873


P-3 Recovery
-1.6
-1.8
-2
-2.2
-2.4
-2.6
-2.8
-3
-3.2
Residual drawdown, s' (ft)
1E1
1E2
1E3
Ratio, t/t'

000874


P-4A Recovery
-1
-1.05
-1.1
-1.15
-1.2
-1.25
-1.3
Residual drawdown, s' (ft)
1E1
1E2
1E3
Ratio, t/t'


P-4B Recovery
Residual drawdown, s' (ft)
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
1E1
1E2
1E3
Ratio, t/t'

P-1 swl = 20.02

date	time vs. drawdown time since pump start	water level	drawdown	
10/02/96	63	20.97	0.95	-0.95
10/02/96	68	20.98	0.96	-0.96
10/02/96	73	20.99	0.97	-0.97
10/02/96	82	21.02	1	-1
10/02/96	92	21.04	1.02	-1.02
10/02/96	102	21.07	1.05	-1.05
10/02/96	112	21.12	1.1	-1.1
10/02/96	127	21.13	1.11	-1.11
10/02/96	143	21.16	1.14	-1.14
10/02/96	177	21.23	1.21	-1.21
10/02/96	202	21.27	1.25	-1.25
10/02/96	247	21.8	1.78	-1.78
10/02/96	247.5	21.6	1.58	-1.58
10/02/96	248	21.21	1.19	-1.19
10/02/96	248.5	21.11	1.09	-1.09
10/02/96	249	21.06	1.04	-1.04
10/02/96	249.5	21.02	1	-1
10/02/96	250	21	0.98	-0.98
10/02/96	250.5	20.97	0.95	-0.95
10/02/96	251	20.96	0.94	-0.94
10/02/96	251.5	20.94	0.92	-0.92
10/02/96	252	20.93	0.91	-0.91
10/02/96	253	20.91	0.89	-0.89
10/02/96	254	20.9	0.88	-0.88
10/02/96	255	20.89	0.87	-0.87
10/02/96	256	20.885	0.865	-0.865
10/02/96	257	20.87	0.85	-0.85
10/02/96	258	20.79	0.77	-0.77
10/02/96	259	20.66	0.64	-0.64
10/02/96	260	20.62	0.6	-0.6
10/02/96	261	20.6	0.58	-0.58
10/02/96	262	20.58	0.56	-0.56
10/02/96	263	20.575	0.555	-0.555
10/02/96	264	20.57	0.55	-0.55
10/02/96	265	20.56	0.54	-0.54
10/02/96	266	20.555	0.535	-0.535
10/02/96	267	20.55	0.53	-0.53
10/02/96	272	20.53	0.51	-0.51
10/02/96	277	20.51	0.49	-0.49
10/02/96	282	20.495	0.475	-0.475
10/02/96	287	20.48	0.46	-0.46
10/02/96	297	20.45	0.43	-0.43
10/02/96	312	20.41	0.39	-0.39
10/02/96	327	20.4	0.38	-0.38
10/02/96	352	20.4	0.38	-0.38
10/02/96	382	20.39	0.37	-0.37
10/02/96	442	21.04	1.02	-1.02
10/02/96	459	21.2	1.18	-1.18
10/02/96	472	21.16	1.14	-1.14
10/02/96	502	21.2	1.18	-1.18
10/02/96	562	21.36	1.34	-1.34

P-1 swl = 20.02

time vs. drawdown

date	time since pump start	water level	drawdown	
10/02/96	620	21.46	1.44	-1.44
10/02/96	656	21.6	1.58	-1.58
10/03/96	1574	22.34	2.32	-2.32
10/03/96	1703	22.44	2.42	-2.42
10/03/96	1760	22.47	2.45	-2.45
10/03/96	1852	22.54	2.52	-2.52
10/03/96	1942	22.59	2.57	-2.57
10/03/96	2190	22.71	2.69	-2.69
10/04/96	2942	23.05	3.03	-3.03
10/04/96	3025	23.07	3.05	-3.05
10/04/96	3146	23.11	3.09	-3.09
10/04/96	3330	23.17	3.15	-3.15
10/04/96	3504	23.24	3.22	-3.22
10/04/96	3558	23.26	3.24	-3.24
10/05/96	4405	23.52	3.5	-3.5
10/08/96	8998	24.36	4.34	-4.34
10/11/96	13318	24.88	4.86	-4.86
10/15/96	19225	25.39	5.37	-5.37
10/18/96	23086	25.58	5.56	-5.56

P-2 swl = 14.14

date	time vs. drawdown time since pump start	water level	drawdown	
10/02/96	95	14.27	0.13	-0.13
10/02/96	104	14.28	0.14	-0.14
10/02/96	130	14.37	0.23	-0.23
10/02/96	143	14.39	0.25	-0.25
10/02/96	179	14.48	0.34	-0.34
10/02/96	204	14.54	0.4	-0.4
10/02/96	477	14.53	0.39	-0.39
10/02/96	504	14.58	0.44	-0.44
10/02/96	564	14.71	0.57	-0.57
10/02/96	622	14.82	0.68	-0.68
10/02/96	646	14.95	0.81	-0.81
10/03/96	1564	15.43	1.29	-1.29
10/03/96	1707	15.61	1.47	-1.47
10/03/96	1762	15.65	1.51	-1.51
10/03/96	1854	15.73	1.59	-1.59
10/03/96	1944	15.79	1.65	-1.65
10/03/96	2179	15.91	1.77	-1.77
10/04/96	2967	16.06	1.92	-1.92
10/04/96	3048	16.08	1.94	-1.94
10/04/96	3152	16.12	1.98	-1.98
10/04/96	3199	16.16	2.02	-2.02
10/04/96	3325	16.25	2.11	-2.11
10/04/96	3523	16.34	2.2	-2.2
10/04/96	3583	16.36	2.22	-2.22
10/05/96	4399	16.4	2.26	-2.26
10/08/96	8981	17.28	3.14	-3.14
10/11/96	13301	17.71	3.57	-3.57
10/15/96	19210	18.21	4.07	-4.07
10/18/96	23089	17.18	3.04	-3.04

P-3 swl = 29.27

	time vs. drawdown			
date	time since pump start	water level	drawdown	
10/02/96	98	29.64	0.37	-0.37
10/02/96	102	29.74	0.47	-0.47
10/02/96	132	29.64	0.37	-0.37
10/02/96	146	29.68	0.41	-0.41
10/02/96	183	29.7	0.43	-0.43
10/02/96	212	29.74	0.47	-0.47
10/02/96	486	29.72	0.45	-0.45
10/02/96	511	29.74	0.47	-0.47
10/02/96	574	29.81	0.54	-0.54
10/02/96	628	29.85	0.58	-0.58
10/02/96	663	29.91	0.64	-0.64
10/03/96	1583	30.36	1.09	-1.09
10/03/96	1718	30.42	1.15	-1.15
10/03/96	1770	30.45	1.18	-1.18
10/03/96	1862	30.48	1.21	-1.21
10/03/96	1952	30.51	1.24	-1.24
10/03/96	2188	30.58	1.31	-1.31
10/04/96	2956	30.8	1.53	-1.53
10/04/96	3038	30.83	1.56	-1.56
10/04/96	3162	30.84	1.57	-1.57
10/04/96	3332	30.91	1.64	-1.64
10/04/96	3513	30.96	1.69	-1.69
10/04/96	3571	30.96	1.69	-1.69
10/05/96	4381	31.12	1.85	-1.85
10/08/96	8986	31.7	2.43	-2.43
10/11/96	13306	32.06	2.79	-2.79
10/15/96	19240	32.47	3.2	-3.2
10/18/96	23095	32.65	3.38	-3.38

P-4A swl = 22.43

	time vs. drawdown			
date	time since pump start	water level	drawdown	
10/03/96	1502	22.79	0.36	-0.36
10/03/96	1728	22.92	0.49	-0.49
10/03/96	1777	22.94	0.51	-0.51
10/03/96	1869	22.98	0.55	-0.55
10/03/96	1988	23.02	0.59	-0.59
10/03/96	2174	23.19	0.76	-0.76
10/04/96	2964	23.21	0.78	-0.78
10/04/96	3045	23.21	0.78	-0.78
10/04/96	3170	23.24	0.81	-0.81
10/04/96	3212	23.28	0.85	-0.85
10/04/96	3326	23.33	0.9	-0.9
10/04/96	3520	23.36	0.93	-0.93
10/04/96	3578	23.38	0.95	-0.95
10/05/96	4420	23.45	1.02	-1.02
10/08/96	8977	24.05	1.62	-1.62
10/11/96	13297	24.35	1.92	-1.92
10/15/96	19205	23.24	0.81	-0.81

P-4B swl = 23.21

	time vs. drawdown			
date	time since pump start	water level	drawdown	
10/03/96	1508	23.58	0.37	-0.37
10/03/96	1729	23.7	0.49	-0.49
10/03/96	1778	23.74	0.53	-0.53
10/03/96	1870	23.76	0.55	-0.55
10/03/96	1989	23.82	0.61	-0.61
10/03/96	2176	23.83	0.62	-0.62
10/04/96	2965	24.03	0.82	-0.82
10/04/96	3046	24.06	0.85	-0.85
10/04/96	3171	24.08	0.87	-0.87
10/04/96	3215	24.11	0.9	-0.9
10/04/96	3328	24.15	0.94	-0.94
10/04/96	3521	24.2	0.99	-0.99
10/04/96	3580	24.22	1.01	-1.01
10/05/96	4421	24.32	1.11	-1.11
10/08/96	8973	24.96	1.75	-1.75
10/11/96	13293	25.32	2.11	-2.11
10/15/96	19207	25.79	2.58	-2.58
10/18/96	23100	25.85	2.64	-2.64

P-5A swl = 19.92

time vs. drawdown

date	time since pump start	water level	drawdown	
10/03/96	1594	19.73	-0.19	0.19
10/03/96	1725	19.74	-0.18	0.18
10/03/96	1775	19.75	-0.17	0.17
10/03/96	1886	19.77	-0.15	0.15
10/03/96	1956	19.78	-0.14	0.14
10/03/96	2171	19.8	-0.12	0.12
10/04/96	2961	19.84	-0.08	0.08
10/04/96	3043	19.85	-0.07	0.07
10/04/96	3173	19.86	-0.06	0.06
10/04/96	3238	19.91	-0.01	0.01
10/04/96	3335	19.9	-0.02	0.02
10/04/96	3518	19.93	0.01	-0.01
10/04/96	3577	19.92	0	0
10/05/96	4435	19.97	0.05	-0.05
10/08/96	8967	20.26	0.34	-0.34
10/11/96	13287	20.43	0.51	-0.51
10/15/96	19215	20.66	0.74	-0.74

P-5B swl = 21.44

date	time vs. drawdown time since pump start	water level	drawdown	
10/03/96	1589	21.42	-0.02	0.02
10/03/96	1721	21.39	-0.05	0.05
10/03/96	1773	21.42	-0.02	0.02
10/03/96	1864	21.42	-0.02	0.02
10/03/96	1954	21.45	0.01	-0.01
10/03/96	2169	21.45	0.01	-0.01
10/04/96	2858	21.49	0.05	-0.05
10/04/96	3040	21.48	0.04	-0.04
10/04/96	3171	21.51	0.07	-0.07
10/04/96	3257	21.54	0.1	-0.1
10/04/96	3337	21.52	0.08	-0.08
10/04/96	3516	21.58	0.14	-0.14
10/04/96	3573	21.54	0.1	-0.1
10/05/96	4432	21.58	0.14	-0.14
10/08/96	8960	21.87	0.43	-0.43
10/11/96	13280	22	0.56	-0.56
10/15/96	19217	22.12	0.68	-0.68
10/18/96	23103	22.24	0.8	-0.8

P-5C swl = 23.42

	time vs. drawdown			
date	time since pump start	water level	drawdown	
10/03/96	1590	23.57	0.15	-0.15
10/03/96	1724	23.52	0.1	-0.1
10/03/96	1774	23.59	0.17	-0.17
10/03/96	1865	23.6	0.18	-0.18
10/03/96	1955	23.59	0.17	-0.17
10/03/96	2170	23.57	0.15	-0.15
10/04/96	2860	23.61	0.19	-0.19
10/04/96	3042	23.6	0.18	-0.18
10/04/96	3172	23.69	0.27	-0.27
10/04/96	3243	23.68	0.26	-0.26
10/04/96	3338	23.64	0.22	-0.22
10/04/96	3517	23.74	0.32	-0.32
10/04/96	3574	23.66	0.24	-0.24
10/05/96	4433	23.69	0.27	-0.27
10/08/96	8963	23.99	0.57	-0.57
10/11/96	13283	24.08	0.66	-0.66
10/15/96	19219	24.17	0.75	-0.75
10/18/96	23104	24.3	0.88	-0.88

Columbin swl = 8.69

date	time vs. drawdown time since pump start	water level	drawdown	
10/02/96	175	8.83	0.14	-0.14
10/02/96	207	8.9	0.21	-0.21
10/02/96	480	8.94	0.25	-0.25
10/02/96	506	8.94	0.25	-0.25
10/02/96	566			
10/02/96	624			
10/02/96	713	9.2	0.51	-0.51
10/03/96	1570	9.4	0.71	-0.71
10/03/96	1712	9.48	0.79	-0.79
10/03/96	1765	9.49	0.8	-0.8
10/03/96	1857	9.52	0.83	-0.83
10/03/96	1947	9.55	0.86	-0.86
10/03/96	2181	9.64	0.95	-0.95
10/04/96	2947	9.86	1.17	-1.17
10/04/96	3033	9.88	1.19	-1.19
10/04/96	3147	9.89	1.2	-1.2
10/04/96	3322	9.96	1.27	-1.27
10/04/96	3507	10.02	1.33	-1.33
10/04/96	3561			
10/05/96	4372	10.21	1.52	-1.52
10/08/96	8983	11.01	2.32	-2.32
10/11/96	13303	11.46	2.77	-2.77
10/15/96	19226	12.05	3.36	-3.36
10/18/96	23068	12.4	3.71	-3.71

Co. Cabin swl = 32.62

date	time vs. drawdown time since pump start	water level	drawdown	
10/02/96	178	33.33	0.71	-0.71
10/02/96	218	33.4	0.78	-0.78
10/02/96	431	33.3	0.68	-0.68
10/02/96	457	33.35	0.73	-0.73
10/02/96	518	33.54	0.92	-0.92
10/02/96	574	33.55	0.93	-0.93
10/03/96	1576	34.35	1.73	-1.73
10/03/96	1713	34.44	1.82	-1.82
10/03/96	1766	34.46	1.84	-1.84
10/03/96	1858	34.52	1.9	-1.9
10/03/96	1948	34.56	1.94	-1.94
10/03/96	2180	34.68	2.06	-2.06
10/04/96	2946	35	2.38	-2.38
10/04/96	3031	35.03	2.41	-2.41
10/04/96	3158	35.06	2.44	-2.44
10/04/96	3314	35.13	2.51	-2.51
10/04/96	3506	35.2	2.58	-2.58
10/04/96	3560	35.22	2.6	-2.6
10/05/96	4388	35.47	2.85	-2.85
10/08/96	8986	36.01	3.39	-3.39
10/11/96	13306	36.49	3.87	-3.87
10/15/96	19240	36.96	4.34	-4.34
10/18/96	23098	37.46	4.84	-4.84

Recovery Test (P-1)
minutes since 10/2 5:38a 23366 swl= 20.02

date	Time pump started (t)	Tme since pump off (t')	t/t'	water level (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23366.5	0.5	46733	25.65	5.63	-5.63
10/18/96	23367	1	23367	25.52	5.5	-5.5
10/18/96	23367.5	1.5	15578	25.48	5.46	-5.46
10/18/96	23368	2	11684	25.44	5.42	-5.42
10/18/96	23368.5	2.5	9347	25.41	5.39	-5.39
10/18/96	23369	3	7790	25.39	5.37	-5.37
10/18/96	23369.5	3.5	6677	25.38	5.36	-5.36
10/18/96	23370	4	5843	25.35	5.33	-5.33
10/18/96	23370.5	4.5	5193	25.34	5.32	-5.32
10/18/96	23371	5	4674	25.33	5.31	-5.31
10/18/96	23371.5	5.5	4249	25.32	5.3	-5.3
10/18/96	23372	6	3895	25.31	5.29	-5.29
10/18/96	23372.5	6.5	3596	25.31	5.29	-5.29
10/18/96	23373	7	3339	25.3	5.28	-5.28
10/18/96	23373.5	7.5	3116	25.3	5.28	-5.28
10/18/96	23374	8	2922	25.29	5.27	-5.27
10/18/96	23374.5	8.5	2750	25.28	5.26	-5.26
10/18/96	23375	9	2597	25.28	5.26	-5.26
10/18/96	23375.5	9.5	2461	25.27	5.25	-5.25
10/18/96	23376	10	2338	25.27	5.25	-5.25
10/18/96	23377	11	2125	25.26	5.24	-5.24
10/18/96	23378	12	1948	25.26	5.24	-5.24
10/18/96	23379	13	1798	25.25	5.23	-5.23
10/18/96	23380	14	1670	25.24	5.22	-5.22
10/18/96	23381	15	1559	25.24	5.22	-5.22
10/18/96	23386	20	1169	25.21	5.19	-5.19
10/18/96	23391	25	936	25.18	5.16	-5.16
10/18/96	23396	30	780	25.16	5.14	-5.14
10/18/96	23406	40	585	25.12	5.1	-5.1
10/18/96	23417	51	459	25.07	5.05	-5.05
10/18/96	23433	67	350	25.02	5	-5
10/18/96	23448	82	286	24.97	4.95	-4.95
10/18/96	23467	101	232	24.92	4.9	-4.9
10/18/96	23504	138	170	24.82	4.8	-4.8
10/18/96	23534	168	140	24.75	4.73	-4.73
10/18/96	23570	204	116	24.67	4.65	-4.65
10/19/96	23770	404	59	24.31	4.29	-4.29
10/19/96	24700	1334	19	23.13	3.11	-3.11
10/19/96	24764	1398	18	23.06	3.04	-3.04
10/19/96	24829	1463	17	23.01	2.99	-2.99
10/19/96	24877	1511	16	22.91	2.89	-2.89
10/19/96	24997	1631	15	22.83	2.81	-2.81
10/19/96	25169	1803	14	22.73	2.71	-2.71
10/19/96	25223	1857	14	22.7	2.68	-2.68

Recovery Test (P-2)

minutes since 10/2 5:38a 23366 swl= 14.14

date	Tme pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdow (ft)	residual drwdwn *(-1) (ft)
10/18/96	23421	55	426	17.79	3.65	-3.65
10/18/96	23435	69	340	17.75	3.61	-3.61
10/18/96	23470	104	226	17.68	3.54	-3.54
10/18/96	23507	141	167	17.63	3.49	-3.49
10/18/96	23536	170	138	17.57	3.43	-3.43
10/18/96	23572	206	114	17.52	3.38	-3.38
10/18/96	23745	379	63	17.28	3.14	-3.14
10/19/96	24703	1337	18	16.08	1.94	-1.94
10/19/96	24766	1400	18	16.03	1.89	-1.89
10/19/96	24831	1465	17	15.97	1.83	-1.83
10/19/96	24959	1593	16	15.89	1.75	-1.75
10/19/96	25000	1634	15	15.82	1.68	-1.68
10/19/96	25172	1806	14	15.82	1.68	-1.68
10/19/96	25226	1860	14	15.78	1.64	-1.64

Recovery Test (P-3)

minutes since 10/2 5:38a	23366	swl=	29.27

date	Time since pump started (t)	Time pump off (t)	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23431	65	360	32.35	3.08	-3.08
10/18/96	23444	78	301	32.33	3.06	-3.06
10/18/96	23457	91	258	32.32	3.05	-3.05
10/18/96	23478	112	210	32.3	3.03	-3.03
10/18/96	23515	149	158	32.26	2.99	-2.99
10/18/96	23548	182	129	32.22	2.95	-2.95
10/18/96	23580	214	110	32.21	2.94	-2.94
10/18/96	23763	397	60	32.04	2.77	-2.77
10/19/96	24712	1346	18	31.31	2.04	-2.04
10/19/96	24775	1409	18	31.24	1.97	-1.97
10/19/96	24839	1473	17	31.21	1.94	-1.94
10/19/96	24893	1527	16	31.18	1.91	-1.91
10/19/96	25008	1642	15	31.12	1.85	-1.85
10/19/96	25181	1815	14	31.03	1.76	-1.76
10/19/96	25235	1869	14	31	1.73	-1.73

Recovery Test (P-4a)
minutes since 10/2 5:38a 23366 swl= 22.43

date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23444	78	301			
10/18/96	23459	93	252			
10/18/96	23480	114	206			
10/18/96	23517	151	156			
10/18/96	23548	182	129			
10/18/96	23583	217	109			
10/18/96	23735	369	64			
10/19/96	24725	1359	18	23.72	1.29	-1.29
10/19/96	24784	1418	17	23.68	1.25	-1.25
10/19/96	24848	1482	17	23.64	1.21	-1.21
10/19/96	24937	1571	16	23.59	1.16	-1.16
10/19/96	25015	1649	15	23.55	1.12	-1.12
10/19/96	25187	1821	14	23.49	1.06	-1.06
10/19/96	25243	1877	13	23.45	1.02	-1.02

Recovery Test (P-4b)
minutes since 10/2 5:38a 23366 swl= 23.21

date	Time pum (t)	Time pum (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1 (ft)
10/18/96	23446	80	293	25.49	2.28	-2.28
10/18/96	23460	94	250	25.46	2.25	-2.25
10/18/96	23481	115	204	25.44	2.23	-2.23
10/18/96	23517	151	156	25.35	2.14	-2.14
10/18/96	23549	183	129	25.32	2.11	-2.11
10/18/96	23584	218	108	25.29	2.08	-2.08
10/18/96	23737	371	64	25.11	1.9	-1.9
10/19/96	24728	1362	18	24.18	0.97	-0.97
10/19/96	24785	1419	17	24.13	0.92	-0.92
10/19/96	24849	1483	17	24.09	0.88	-0.88
10/19/96	24938	1572	16	24.06	0.85	-0.85
10/19/96	25016	1650	15	24.01	0.8	-0.8
10/19/96	25188	1822	14	23.93	0.72	-0.72
10/19/96	25245	1879	13	23.89	0.68	-0.68

Recovery Test (P-5a)
minutes since 10/2 5:38a 23366 swl= 19.92

date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23465	99	237	21.08	1.16	-1.16
10/18/96	23485	119	197	21.09	1.17	-1.17
10/18/96	23521	155	152	21.08	1.16	-1.16
10/18/96	23560	194	121	21.08	1.16	-1.16
10/18/96	23589	223	106	21.08	1.16	-1.16
10/18/96	23724	358	66	21.07	1.15	-1.15
10/19/96	24724	1358	18	20.85	0.93	-0.93
10/19/96	24788	1422	17	20.82	0.9	-0.9
10/19/96	24852	1486	17	20.83	0.91	-0.91
10/19/96	24950	1584	16	20.82	0.9	-0.9
10/19/96	25020	1654	15	20.81	0.89	-0.89
10/19/96	25191	1825	14	20.78	0.86	-0.86
10/19/96	25240	1874	13	20.77	0.85	-0.85

Recovery Test (P-5b)
minutes since 10/2 5:38a 23366 swl= 21.44

date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23523	157	150	22.22	0.78	-0.78
10/18/96	23564	198	119	22.22	0.78	-0.78
10/18/96	23591	225	105	22.23	0.79	-0.79
10/18/96	23708	342	69	22.21	0.77	-0.77
10/19/96	24721	1355	18	21.93	0.49	-0.49
10/19/96	24786	1420	17	21.93	0.49	-0.49
10/19/96	24849	1483	17	21.91	0.47	-0.47
10/19/96	24935	1569	16	21.9	0.46	-0.46
10/19/96	25018	1652	15	21.92	0.48	-0.48
10/19/96	25189	1823	14	21.87	0.43	-0.43
10/19/96	25237	1871	13	21.85	0.41	-0.41

Recovery Test (P-5c)

minutes since 10/2 5:38a 23366 swl= 23.42

date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23463	97	242	24.26	0.84	-0.84
10/18/96	23488	122	193	24.5	1.08	-1.08
10/18/96	23524	158	149	24.25	0.83	-0.83
10/18/96	23567	201	117	24.23	0.81	-0.81
10/18/96	23592	226	104	24.23	0.81	-0.81
10/18/96	23718	352	67	24.2	0.78	-0.78
10/19/96	24722	1356	18	23.89	0.47	-0.47
10/19/96	24787	1421	17	23.88	0.46	-0.46
10/19/96	24851	1485	17	23.87	0.45	-0.45
10/19/96	24922	1556	16	23.84	0.42	-0.42
10/19/96	25019	1653	15	23.89	0.47	-0.47
10/19/96	25190	1824	14	23.79	0.37	-0.37
10/19/96	25238	1872	13	23.82	0.4	-0.4

Recovery Test (Company Cabins Well)

minutes since 10/2 5:38a 23366 swl= 32.62

date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1) (ft)
10/18/96	23428	62	378	37.06	4.44	-4.44
10/18/96	23441	75	313	37.05	4.43	-4.43
10/18/96	23455	89	264	37.01	4.39	-4.39
10/18/96	23476	110	213	36.98	4.36	-4.36
10/18/96	23513	147	160	36.91	4.29	-4.29
10/18/96	23545	179	132	36.85	4.23	-4.23
10/18/96	23578	212	111	36.8	4.18	-4.18
10/18/96	23760	394	60	36.55	3.93	-3.93
10/19/96	24709	1343	18	35.5	2.88	-2.88
10/19/96	24773	1407	18	35.43	2.81	-2.81
10/19/96	24837	1471	17	35.37	2.75	-2.75
10/19/96	25000	1634	15	35.23	2.61	-2.61
10/19/96	25178	1812	14	35.12	2.5	-2.5
10/19/96	25232	1866	14	35.07	2.45	-2.45

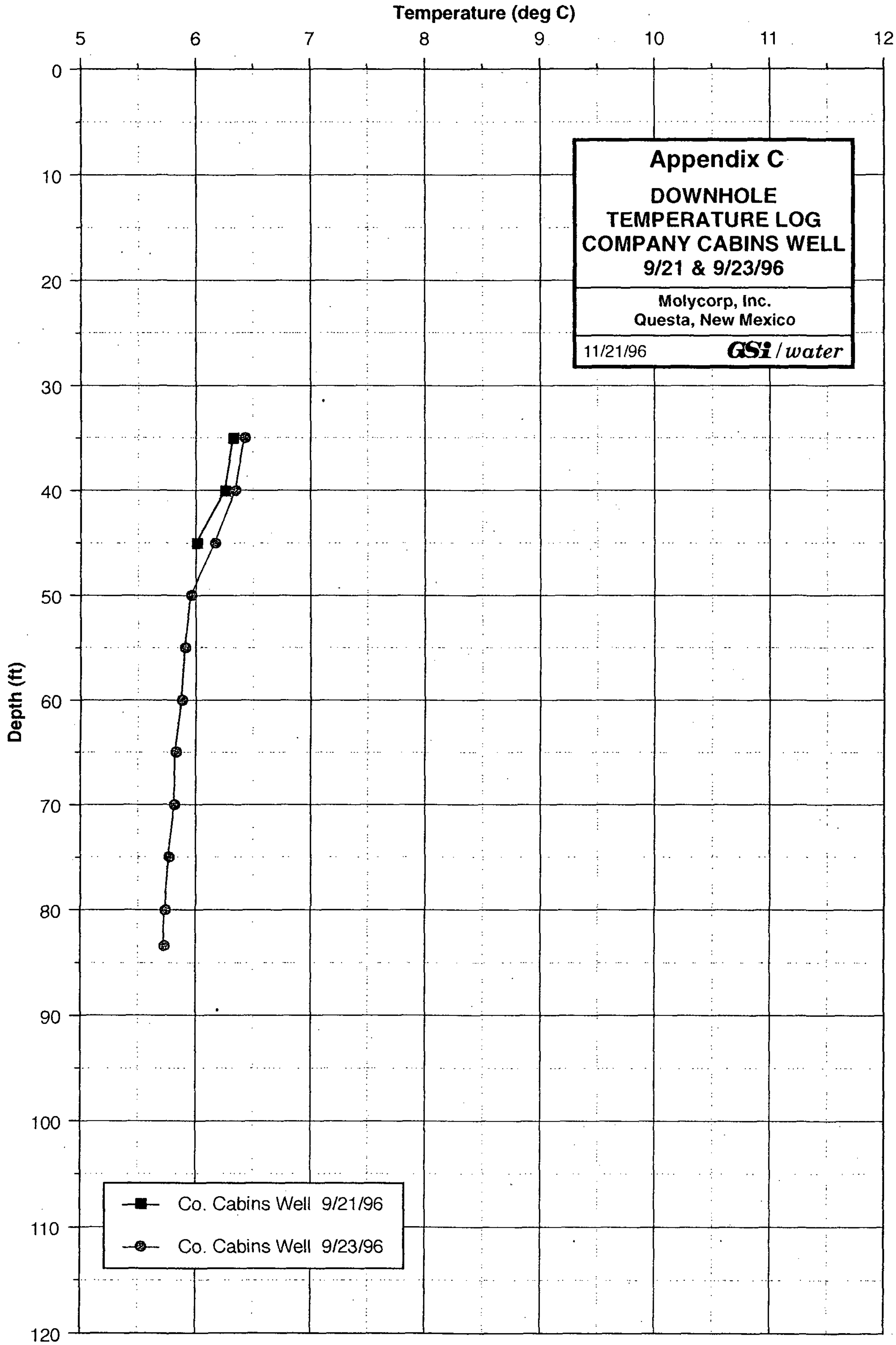
Recovery Test (Columbine Well 1)

minutes since 10/2 5:38a 23366 swl= 8.69

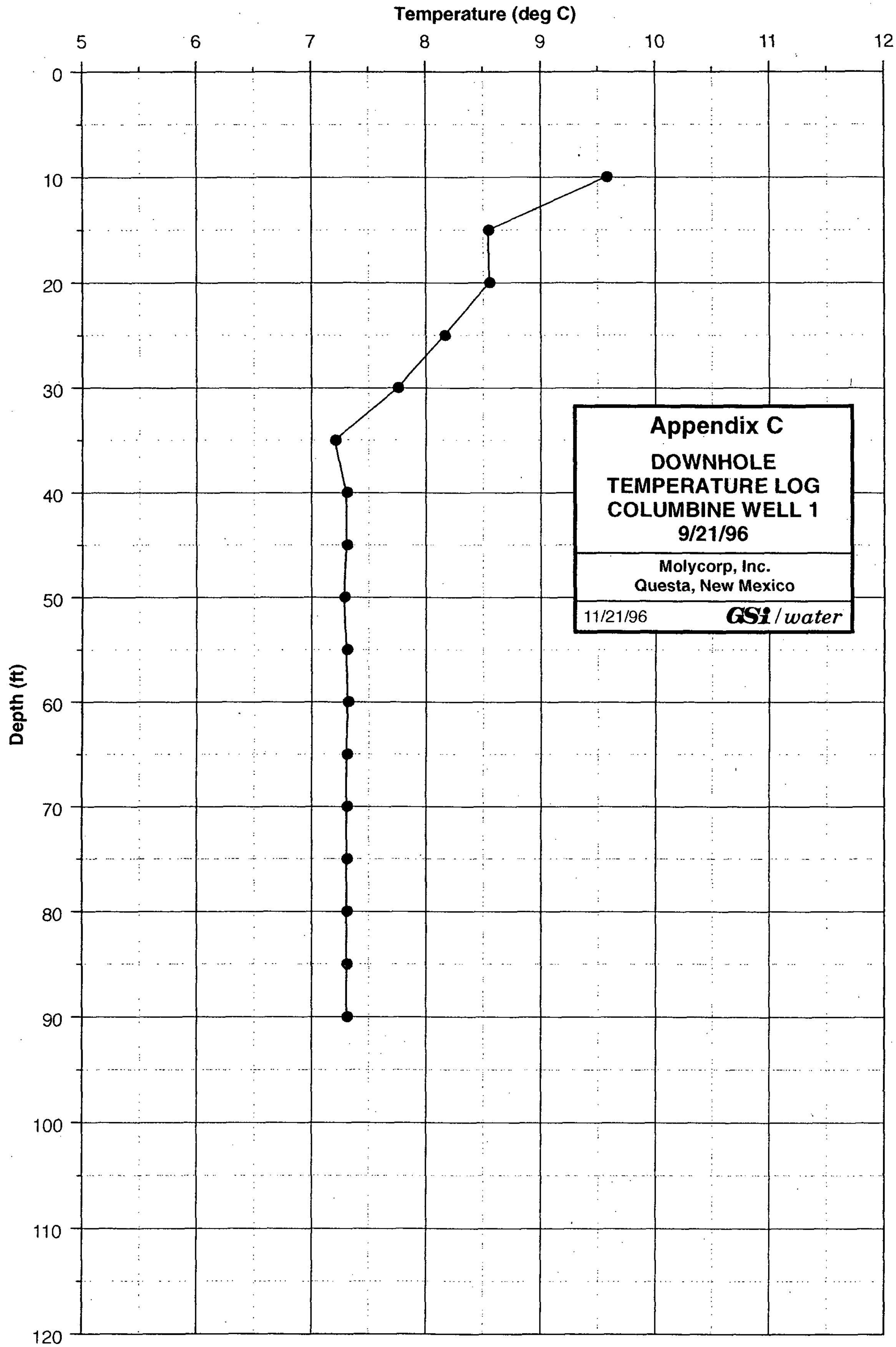
date	Time pump started (t)	Time pump off (t')	t/t'	waterlevel (ft)	residual drawdown (ft)	residual drwdwn *(-1 (ft)
10/18/96	23425	59	397	12.32	3.63	-3.63
10/18/96	23438	72	326	12.29	3.6	-3.6
10/18/96	23452	86	273	12.3	3.61	-3.61
10/18/96	23473	107	219	12.28	3.59	-3.59
10/18/96	23509	143	164	12.27	3.58	-3.58
10/18/96	23542	176	134	12.26	3.57	-3.57
10/18/96	23585	219	108	12.25	3.56	-3.56
10/18/96	23755	389	61	12.17	3.48	-3.48
10/19/96	24705	1339	18	11.53	2.84	-2.84
10/19/96	24769	1403	18	11.46	2.77	-2.77
10/19/96	24835	1469	17	11.4	2.71	-2.71
10/19/96	24997	1631	15	11.31	2.62	-2.62
10/19/96	25173	1807	14			
10/19/96	25230	1864	14	11.54	2.85	-2.85

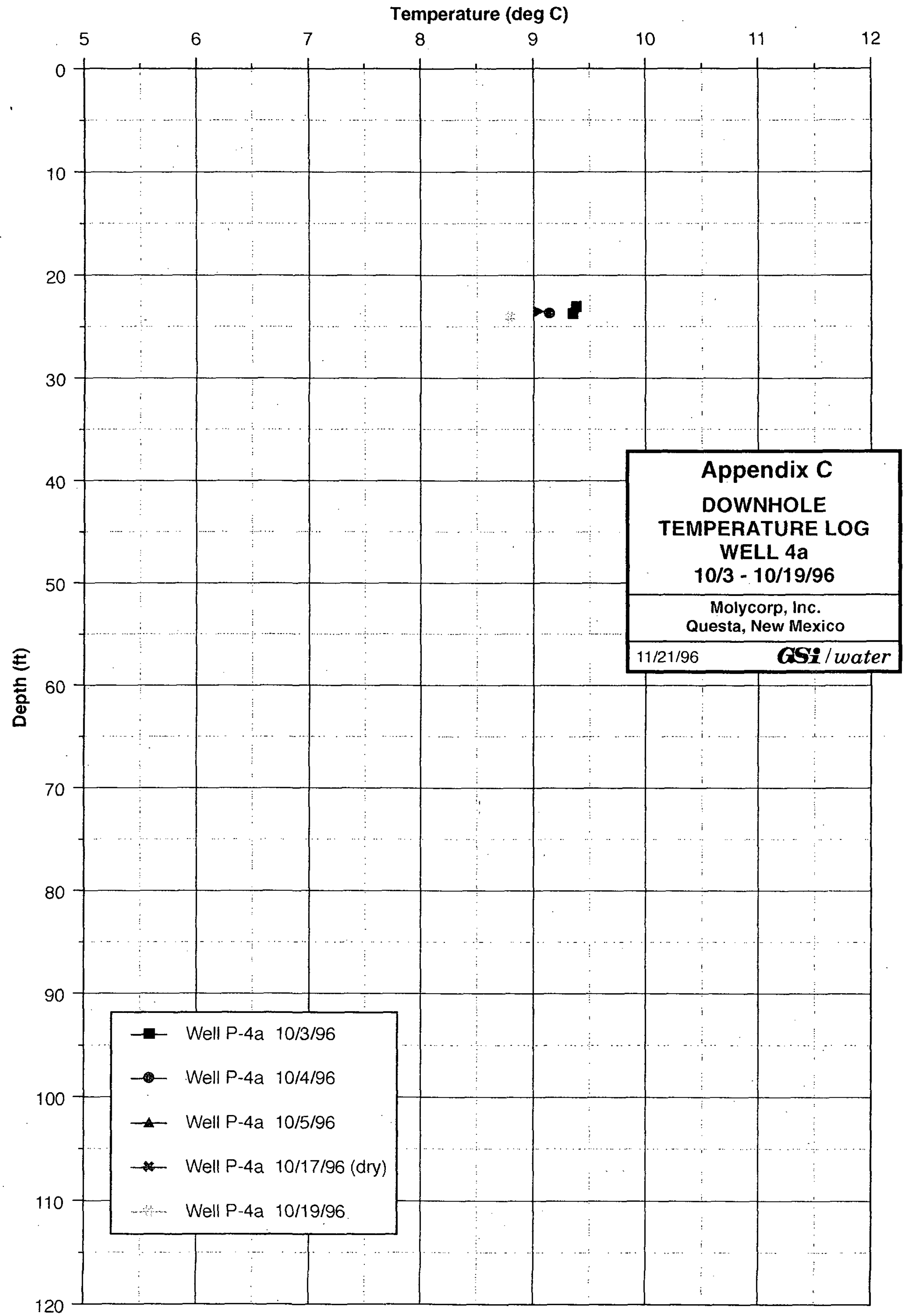
Appendix C

Downhole Temperature Data


Temperature (deg C)
5
6
7
8
9
10
11
12
0
10
20
30
40
50
60
70
80
90
100
110
120
Depth (ft)
Appendix C
DOWNHOLE TEMPERATURE LOG
COMPANY CABINS WELL
9/21 & 9/23/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water
Co. Cabins Well 9/21/96
Co. Cabins Well 9/23/96

000899


Temperature (deg C)
5
6
7
8
9
10
11
12
0
10
20
30
40
50
60
70
80
90
100
110
120
Depth (ft)
Appendix C
DOWNHOLE
TEMPERATURE LOG
COLUMBINE WELL 1
9/21/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water



Temperature (deg C)
5
6
7
8
9
10
11
12
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
Well P-4a 10/3/96
Well P-4a 10/4/96
Well P-4a 10/5/96
Well P-4a 10/17/96 (dry)
Well P-4a 10/19/96
Appendix C
DOWNHOLE
TEMPERATURE LOG
WELL 4a
10/3 - 10/19/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water

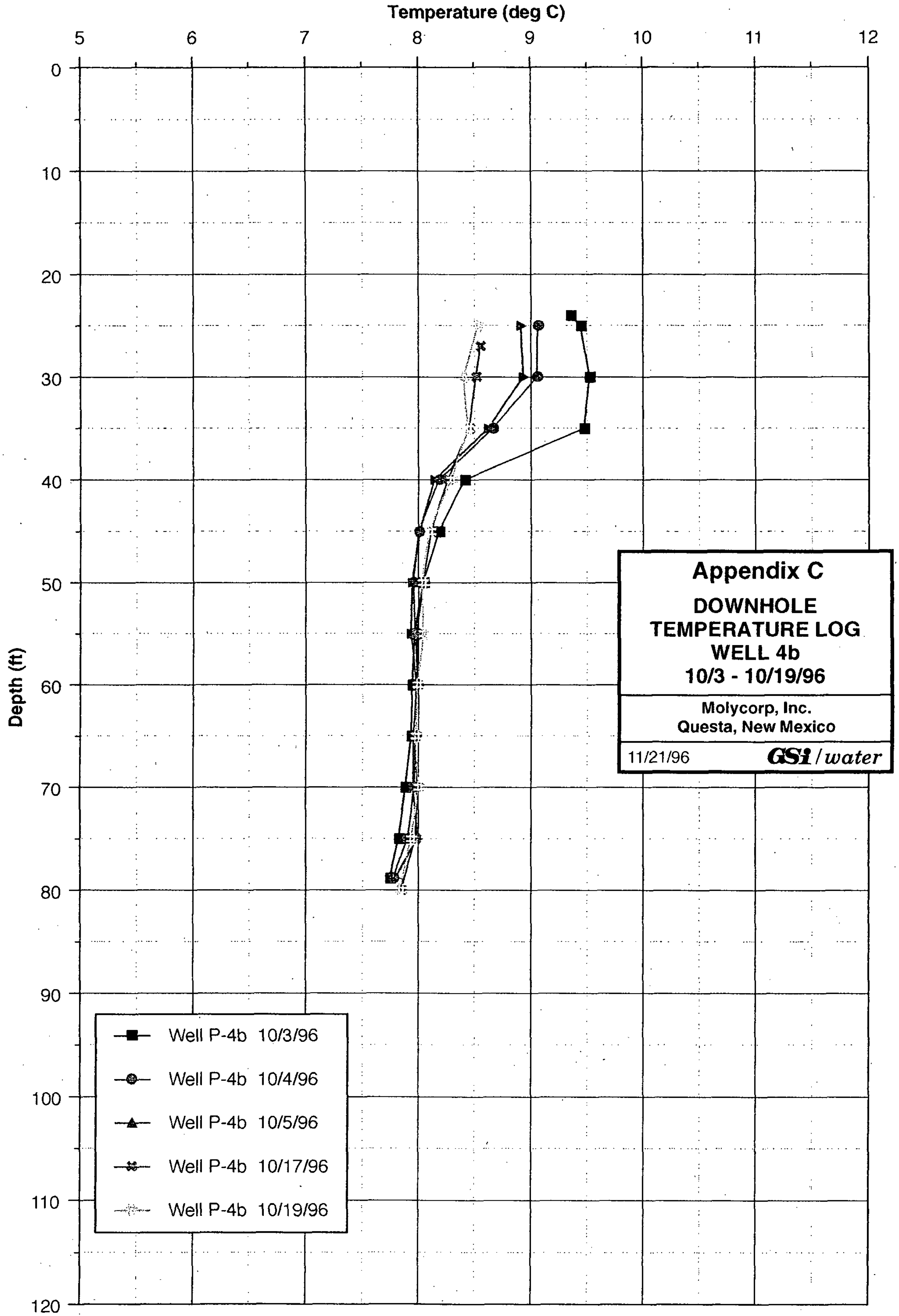
000901

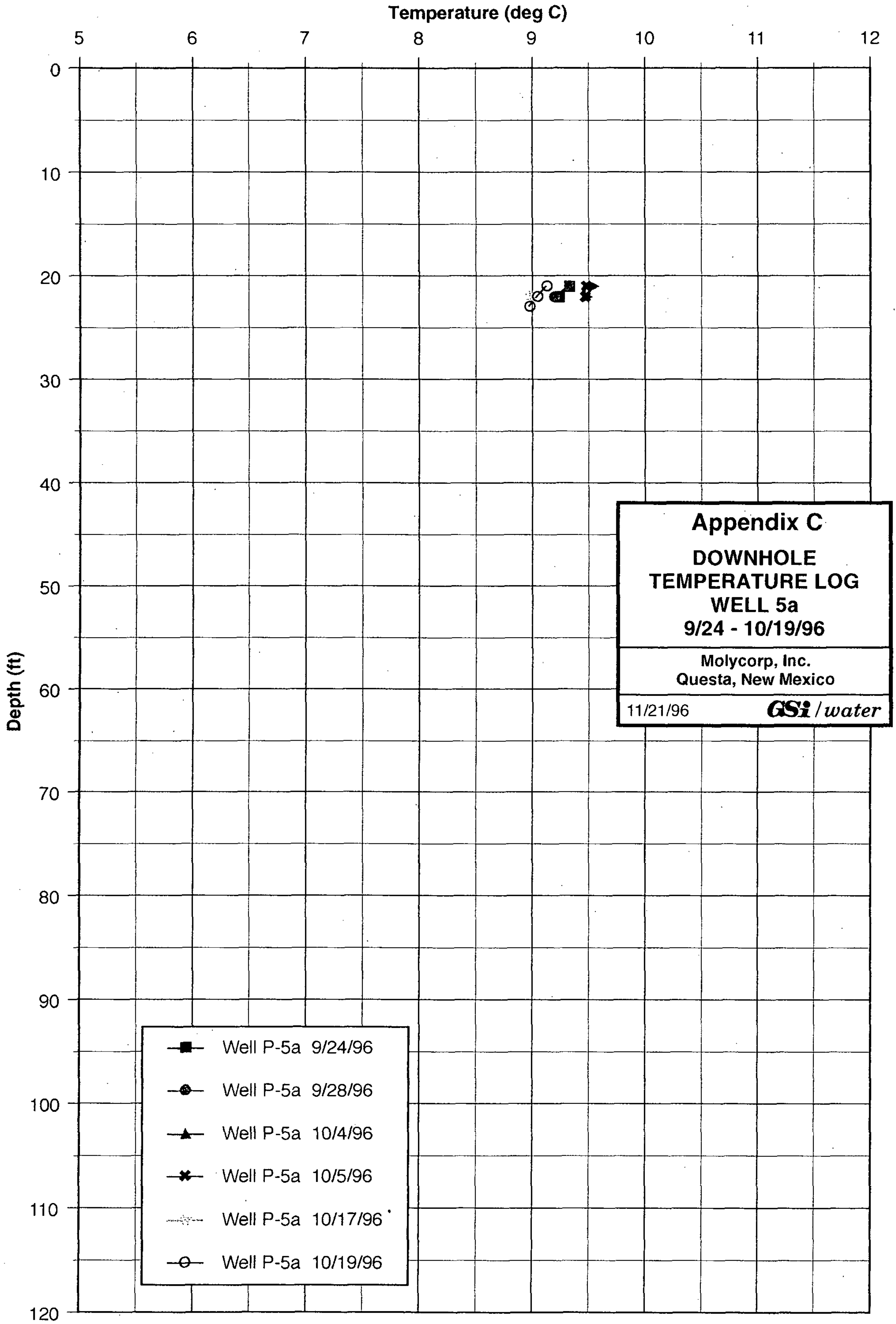
Appendix C

DOWNHOLE TEMPERATURE LOG
WELL 4b
10/3 - 10/19/96

Molycorp, Inc.
Questa, New Mexico

11/21/96 GSi/water



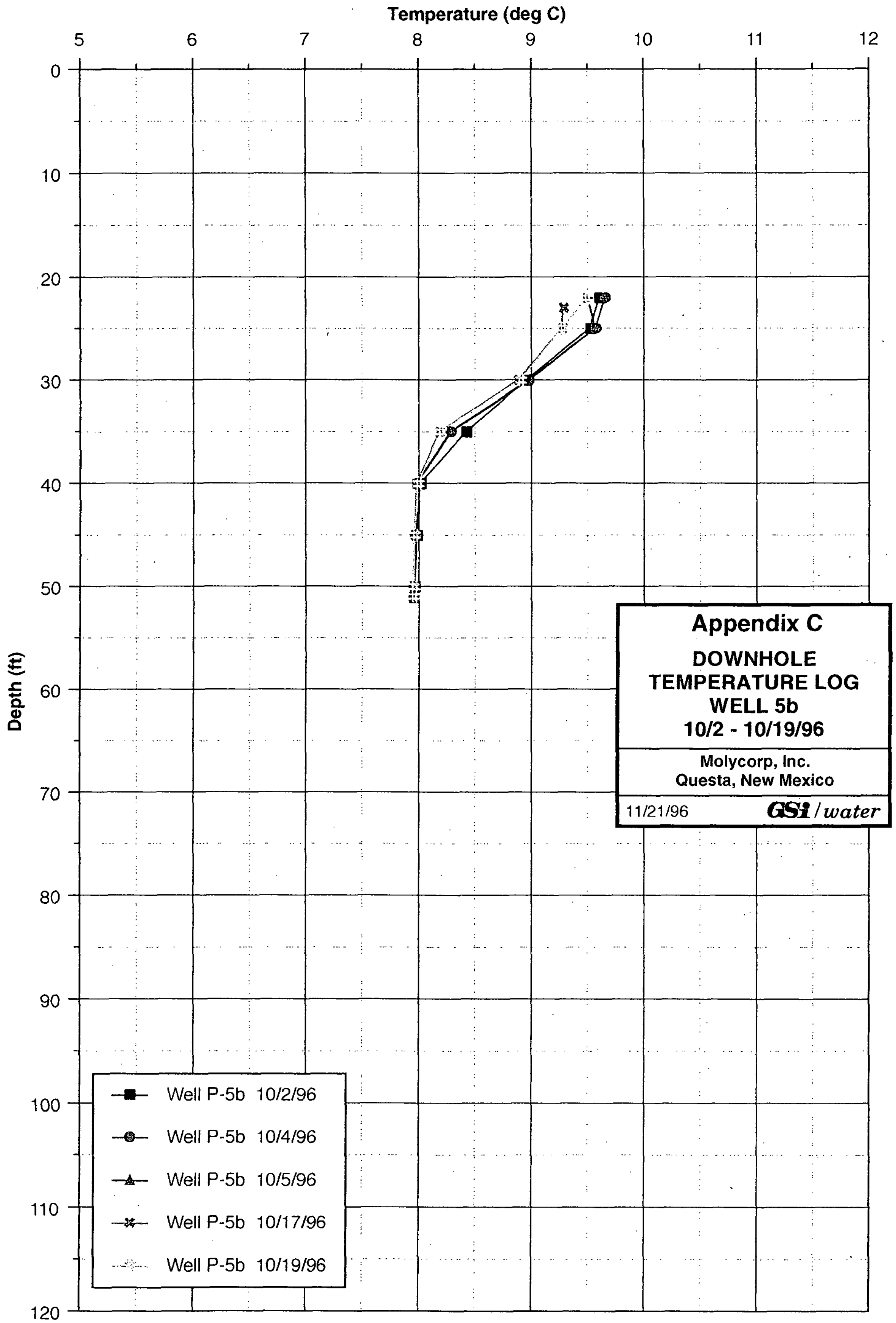


Appendix C

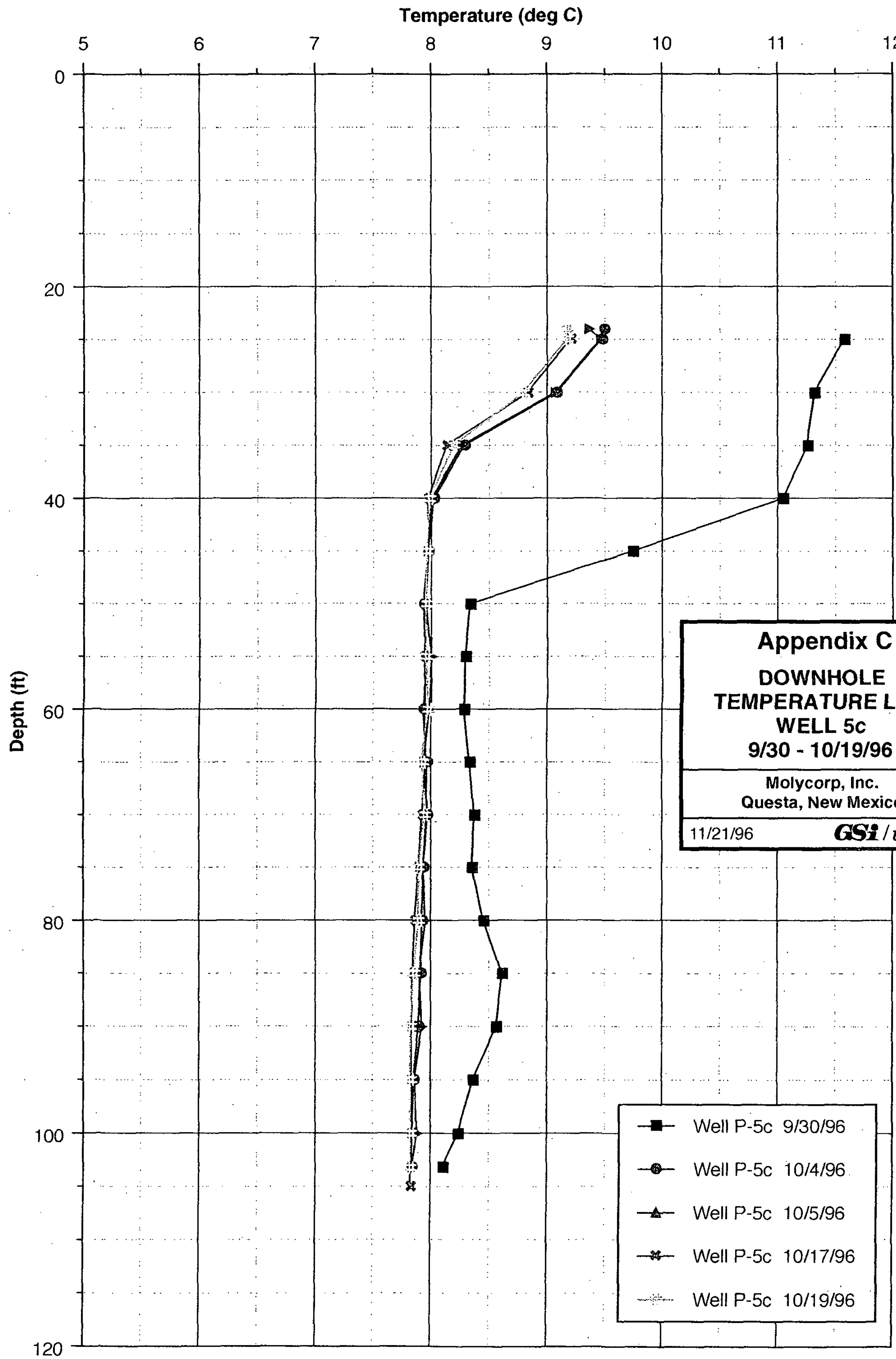
DOWNHOLE TEMPERATURE LOG WELL 5a 9/24 - 10/19/96

Molycorp, Inc.
Questa, New Mexico

11/21/96 GSi/water



Temperature (deg C)
5
6
7
8
9
10
11
12
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
Appendix C
DOWNHOLE TEMPERATURE LOG
WELL 5b
10/2 - 10/19/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water
Well P-5b 10/2/96
Well P-5b 10/4/96
Well P-5b 10/5/96
Well P-5b 10/17/96
Well P-5b 10/19/96



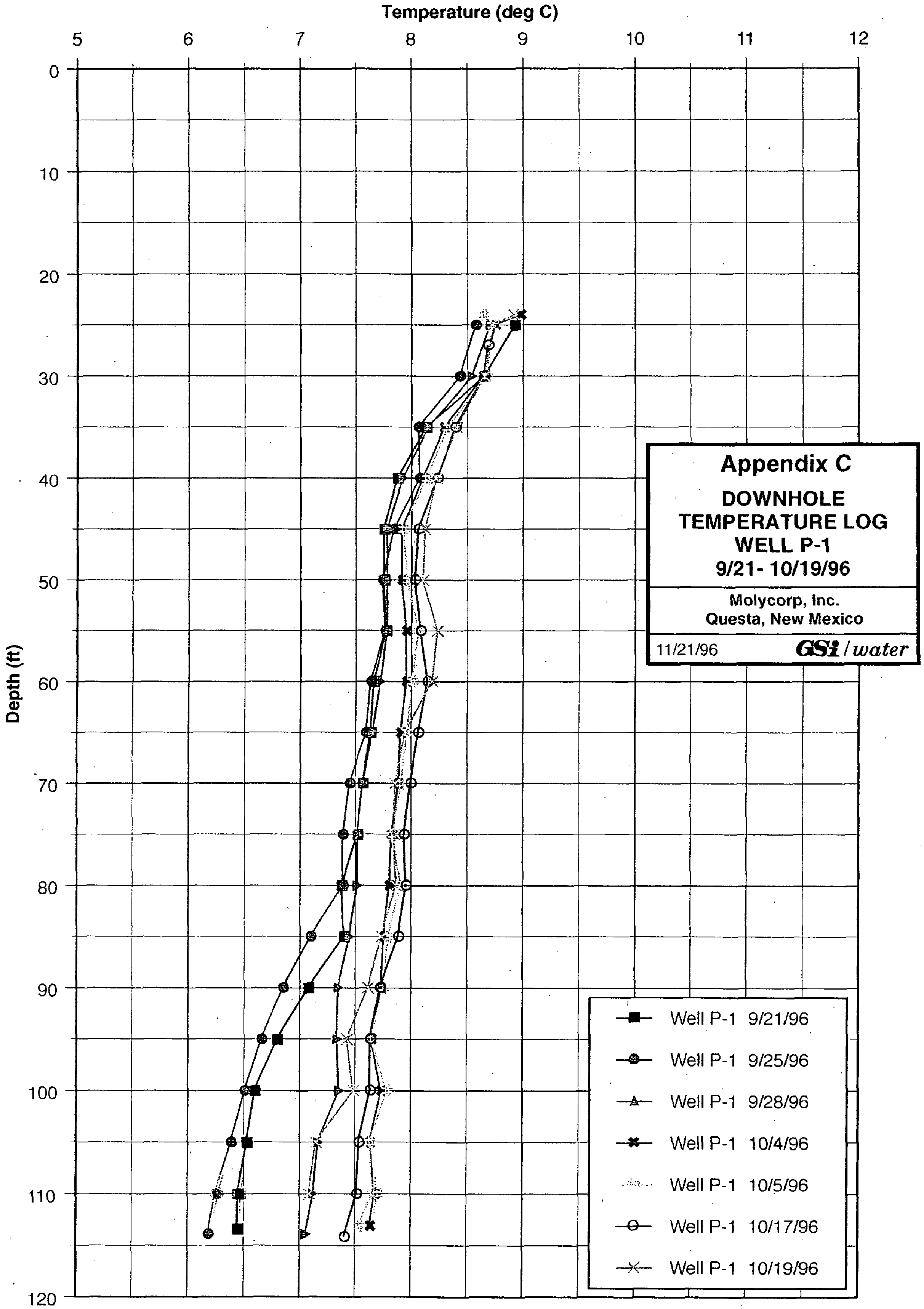
Appendix C

DOWNHOLE TEMPERATURE LOG WELL 5c 9/30 - 10/19/96

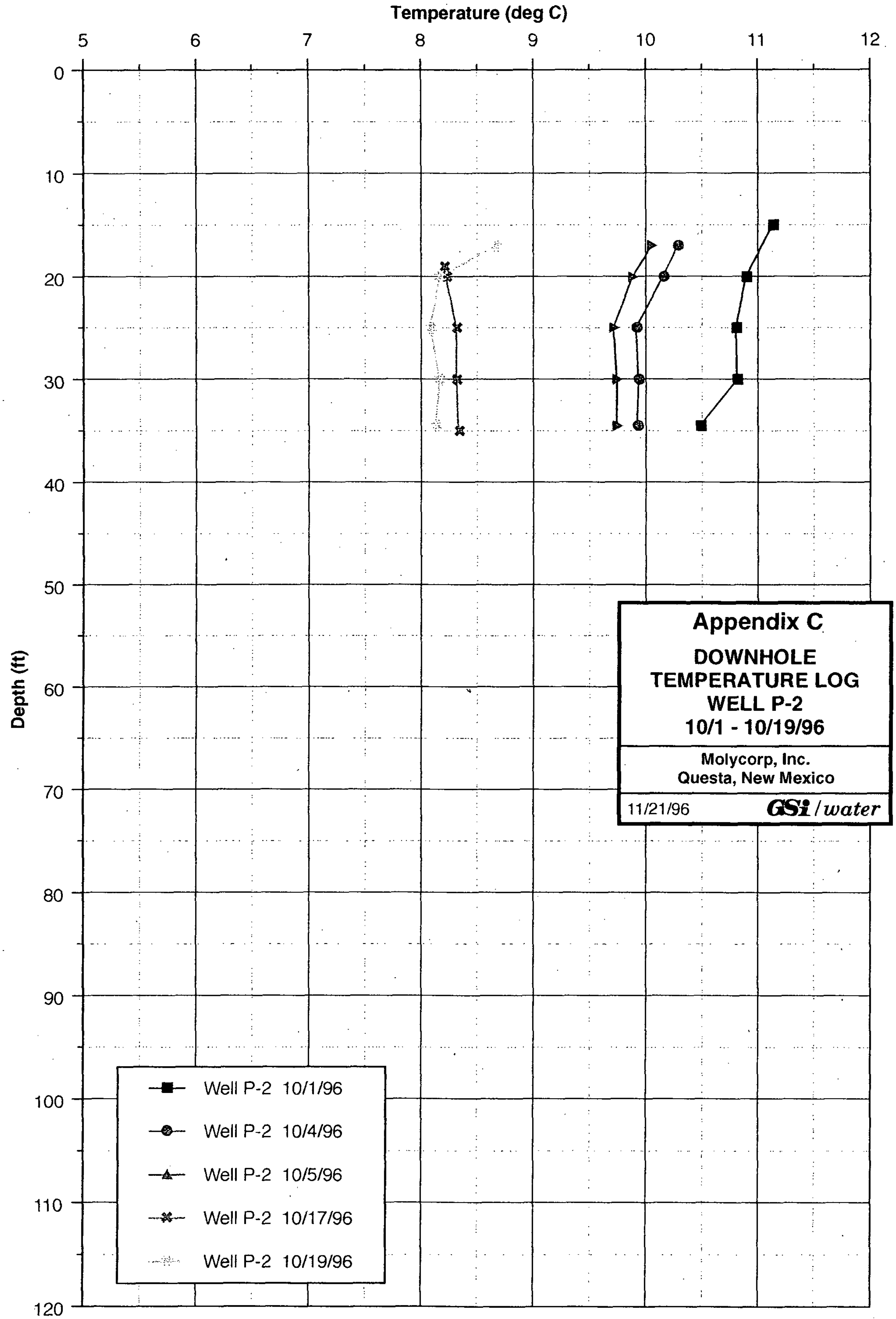
Molycorp, Inc.
Questa, New Mexico

11/21/96 GSi/water

000905



Temperature (deg C)
5
6
7
8
9
10
11
12
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
Appendix C
DOWNHOLE TEMPERATURE LOG
WELL P-1
9/21- 10/19/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water
Well P-1 9/21/96
Well P-1 9/25/96
Well P-1 9/28/96
Well P-1 10/4/96
Well P-1 10/5/96
Well P-1 10/17/96
Well P-1 10/19/96

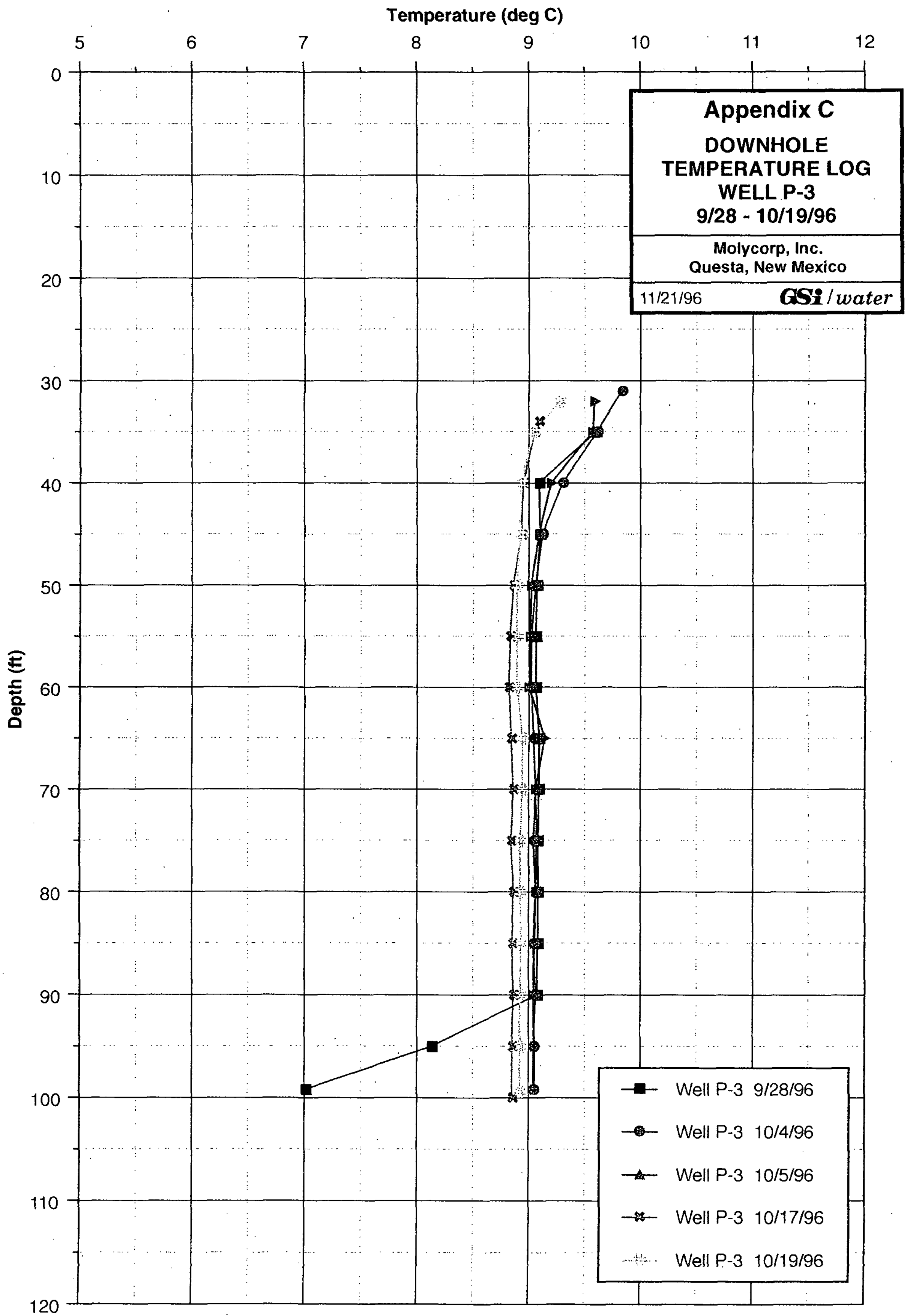


Appendix C

DOWNHOLE TEMPERATURE LOG WELL P-2 10/1 - 10/19/96

Molycorp, Inc.
Questa, New Mexico

11/21/96 GSi/water



Temperature (deg C)
5
6
7
8
9
10
11
12
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
Appendix C
DOWNHOLE TEMPERATURE LOG
WELL P-3
9/28 - 10/19/96
Molycorp, Inc.
Questa, New Mexico
11/21/96
GSi / water
Well P-3 9/28/96
Well P-3 10/4/96
Well P-3 10/5/96
Well P-3 10/17/96
Well P-3 10/19/96

000908

Well P-1													
9/21/96		9/25/96		9/28/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
25	8.92	25	8.57	25	8.7	24	8.97	24	8.64	27	8.68	24	8.91
30	8.65	30	8.43	30	8.54	25	8.74	25	8.72	30	8.65	25	8.73
35	8.13	35	8.06	35	8.15	30	8.64	30	8.67	35	8.39	30	8.65
40	7.87	40	8.07	40	7.92	35	8.29	35	8.32	40	8.23	35	8.4
45	7.75	45	7.84	45	7.78	40	8.1	40	8.13	45	8.06	40	8.22
50	7.75	50	7.74	50	7.78	45	7.91	45	7.92	50	8.03	45	8.12
55	7.77	55	7.76	55	7.78	50	7.91	50	7.96	55	8.08	50	8.1
60	7.66	60	7.63	60	7.72	55	7.95	55	8.06	60	8.14	55	8.23
65	7.63	65	7.59	65	7.65	60	7.95	60	8	65	8.06	60	8.18
70	7.56	70	7.44	70	7.56	65	7.9	65	7.96	70	7.99	65	7.94
75	7.51	75	7.38	75	7.51	70	7.88	70	7.9	75	7.93	70	7.85
80	7.37	80	7.38	80	7.51	75	7.82	75	7.83	80	7.95	75	7.84
85	7.39	85	7.09	85	7.44	80	7.8	80	7.9	85	7.88	80	7.86
90	7.07	90	6.84	90	7.34	85	7.75	85	7.79	90	7.72	85	7.73
95	6.79	95	6.65	95	7.33	90	7.73	90	7.75	95	7.63	90	7.61
100	6.59	100	6.5	100	7.35	95	7.64	95	7.64	100	7.63	95	7.42
105	6.52	105	6.38	105	7.16	100	7.73	100	7.78	105	7.53	100	7.48
110	6.44	110	6.24	110	7.12	105	7.63	105	7.63	110	7.51	105	7.14
113.4	6.44	113.87	6.18	113.87	7.05	110	7.67	110	7.65	114.15	7.4	110	7.08
						113.1	7.63	113.1	7.53				
												GSi/water	
												11/27/96	

Well P-2									
10/1/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
15	11.13	17	10.28	17	10.05	19	8.2	17	8.66
20	10.89	20	10.15	20	9.88	20	8.22	20	8.16
25	10.8	25	9.91	25	9.71	25	8.31	25	8.08
30	10.81	30	9.93	30	9.74	30	8.31	30	8.16
34.5	10.48	34.5	9.92	34.5	9.74	35	8.33	34.45	8.13
								GSi/water	
								11/27/96	

Well P-3									
9/28/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
35	9.6	31	9.83	32	9.59	34	9.09	32	9.28
40	9.09	35	9.61	35	9.57	35	9.05	35	9.04
45	9.1	40	9.3	40	9.2	40	8.95	40	8.93
50	9.07	45	9.12	45	9.09	45	8.93	45	8.92
55	9.06	50	9.06	50	9.02	50	8.86	50	8.89
60	9.06	55	9.02	55	9.01	55	8.83	55	8.89
65	9.09	60	9.02	60	9	60	8.82	60	8.89
70	9.09	65	9.04	65	9.14	65	8.84	65	8.94
75	9.08	70	9.06	70	9.06	70	8.86	70	8.94
80	9.08	75	9.04	75	9.07	75	8.84	75	8.92
85	9.08	80	9.06	80	9.06	80	8.86	80	8.92
90	9.07	85	9.04	85	9.05	85	8.85	85	8.93
95	8.13	90	9.06	90	9.04	90	8.86	90	8.92
99.2	7.01	95	9.04	95	9.05	95	8.85	95	8.92
		99.2	9.04	99.2	9.05	100	8.85	99.4	8.92
								GSi/water	
								11/27/96	

Well P-4a									
10/3/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
23	9.37	23.68	9.13	23.5	9.04		dry	24	8.78
23.68	9.34								
								GSi/water	
								11/27/96	

Well P-4b									
10/3/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
24	9.35	25	9.06	25	8.91	27	8.55	25	8.53
25	9.44	30	9.05	30	8.93	30	8.51	30	8.4
30	9.52	35	8.66	35	8.62	35	8.45	35	8.44
35	9.47	40	8.18	40	8.14	40	8.26	40	8.29
40	8.41	45	8	45	8.01	45	8.11	45	8.09
45	8.18	50	7.95	50	7.94	50	8.04	50	8.03
50	8.04	55	7.97	55	7.93	55	7.98	55	8.04
55	7.96	60	7.99	60	7.98	60	7.99	60	7.99
60	7.94	65	7.97	65	7.95	65	7.97	65	7.97
65	7.93	70	7.96	70	7.95	70	7.99	70	8
70	7.88	75	7.9	75	7.99	75	7.97	75	7.93
75	7.82	78.82	7.77	78.82	7.79	80	7.84	80	7.83
78.82	7.74								
								GSi/water	
								11/27/96	

Well P-5a

9/24/96		9/28/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
21	9.32	21	9.32	21	9.54	21	9.47	22	8.98	21	9.12
22	9.23	22	9.19	22	9.48	22	9.46			22	9.04
										22.94	8.97

GSi/water

11/27/96

Well P-5b									
10/2/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
22	9.6	22	9.65	22	9.5	23	9.28	22	9.49
25	9.52	25	9.57	25	9.57	25	9.27	25	9.27
30	8.95	30	8.97	30	8.98	30	8.88	30	8.9
35	8.42	35	8.28	35	8.29	35	8.18	35	8.19
40	8.01	40	7.98	40	7.98	40	7.98	40	7.99
45	7.98	45	7.96	45	7.97	45	7.96	45	7.96
50	7.96	50	7.95	50	7.96	50	7.96	50	7.95
51.05	7.95	51.05	7.95	51.05	7.95			50.95	7.95
								GSi/water	
								11/27/96	

Well P-5c									
9/30/96		10/4/96		10/5/96		10/17/96		10/19/96	
Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp	Depth	Temp
25	11.57	24	9.49	24	9.36	25	9.2	24	9.17
30	11.31	25	9.47	25	9.46	30	8.83	25	9.17
35	11.25	30	9.08	30	9.07	35	8.13	30	8.79
40	11.04	35	8.28	35	8.26	40	7.97	35	8.19
45	9.74	40	8.02	40	8	45	7.97	40	7.98
50	8.33	45	7.97	45	7.97	50	7.95	45	7.96
55	8.29	50	7.93	50	7.95	55	7.94	50	7.95
60	8.28	55	7.95	55	8	60	7.94	55	7.95
65	8.33	60	7.93	60	7.98	65	7.95	60	7.97
70	8.37	65	7.96	65	7.94	70	7.92	65	7.92
75	8.35	70	7.96	70	7.97	75	7.89	70	7.94
80	8.45	75	7.93	75	7.93	80	7.86	75	7.89
85	8.61	80	7.92	80	7.95	85	7.84	80	7.89
90	8.56	85	7.91	85	7.9	90	7.83	85	7.85
95	8.36	90	7.89	90	7.92	95	7.83	90	7.82
100	8.23	95	7.85	95	7.86	100	7.83	95	7.82
103.15	8.1	100	7.84	100	7.88	105	7.82	100	7.82
		103.15	7.83	103.15	7.84			103.25	7.82
								GSi/water	
								11/27/96	

	Columbine Well 1			Company Cabins Well			
	9/21/96			9/21/96		9/23/96	
	Depth	Temp		Depth	Temp	Depth	Temp
	10	9.57		35	6.32	35	6.42
	15	8.54		40	6.25	40	6.34
	20	8.55		45	6	45	6.16
	25	8.16				50	5.95
	30	7.75				55	5.9
	35	7.2				60	5.87
	40	7.3				65	5.82
	45	7.3				70	5.81
	50	7.28				75	5.76
	55	7.3				80	5.73
	60	7.31				83.4	5.72
	65	7.3					
	70	7.3					
	75	7.3					
	80	7.3					
	85	7.3					
	90	7.3					
							GSi/water
							11/27/96

Appendix D

Water Quality Data

pH for all river stations and springs R=river; S=spring

Location	3	10	14	11	1	2	13	12	5	4	6	9	8	7	15	16
Type	R	S	R	S	S	R	R	R	S	S	S	S	R	S	R	R
09/15/96	7.1	5.8	6.7	4.9	4.3	6.2	6.4	6.8	4.9	4.7	4.5	4.7	5.9	4.5		
09/18/96		5.5		4.8	4.6				4.8	4.7	4.6	4.7		4.6		
09/21/96	6.5	5.8	6.4	4.8	4.8	6.6	6.5	6.2	5	4.7	4.6	4.7	6.1	4.7		
09/23/96	6.5	5.8	6.3	4.8	4.8	6.7	6.5	6.3	5.1	4.9	4.8	5	6.1	4.8		
09/24/96	6.8	5.7	6.7	5	4.9	6.9	6.7	6.4	5.1	5	4.9	5	6.3	5	6.9	
09/28/96											4.5	4.6	5.6	4.6	6.1	
09/29/96	6.9	5.5	6.9	4.9	4.8	6.7	6.3	6.3	5	5						
10/03/96	6.3	6	6.2	4.9	4.9	6.5	6.4	6.2	5	5	4.7	4.9	6	4.9	6.8	7
10/04/96	6.1	n/a	6.3	4.4	4.5	6.1	6.3	6.5	4.8	4.7	4.5	4.9	5.8	4.4	5.9	6.1
10/05/96													6.1			
10/17/96	7.1	n/a	7.8	5	4.5	7.2	7.3	7.3	n/a	n/a	n/a	5.1	6.9	n/a	6.9	7.1
10/18/96	7.1	n/a	7.7	4.9	4.7	7	7.2	7.4	n/a	n/a	n/a	5.1	6.6	n/a	6.9	7.1
10/19/96	7	n/a	7.3	4.9	4.7	6.8	7.2	7.3	5	5.1	n/a	5.1	6.5	n/a	6.9	7

GSi/water

Conductance (umhos/cm) for all river stations and springs R=river; S=spring

Location	3	10	14	11	1	2	13	12	5	4	6	9	8	7	15	16
Type	R	S	R	S	S	R	R	R	S	S	S	S	R	S	R	R
09/15/96	280	560	280	1310	1790	300	310	300	1430	1710	1780	1530	410	1740		
09/18/96		580		1370	1760				1440	1700	1730	1530		1700		
09/21/96	290	600	310	1480	1780	320	310	310	1410	1720	1770	1550	410	1750		
09/23/96	290	610	310	1440	1780	320	300	320	1450	1650	1600	1500	450	1740		
09/24/96	280	610	310	1450	1800	300	320	330	1430	1580	1760	1510	440	1750	350	
09/28/96											1640	1440	390	1640	310	
09/29/96	280	620	290	1420	1740	290	290	290	1330	1610						
10/03/96	300	600	300	1400	1700	300	300	300	1300	1500	1600	1500	400	1600	360	370
10/04/96	300	n/a	300	1700	2000	300	300	300	1600	1600	1800	1600	500	1800	400	400
10/05/96													400			
10/17/96	340	n/a	380	1450	1720	300	320	310	n/a	n/a	n/a	1370	360	n/a	330	380
10/18/96	280	n/a	320	1420	1680	290	310	300	n/a	n/a	n/a	1380	380	n/a	340	320
10/19/96	260	n/a	350	1590	1740	330	340	330	1460	1360	n/a	1480	430	n/a	350	350

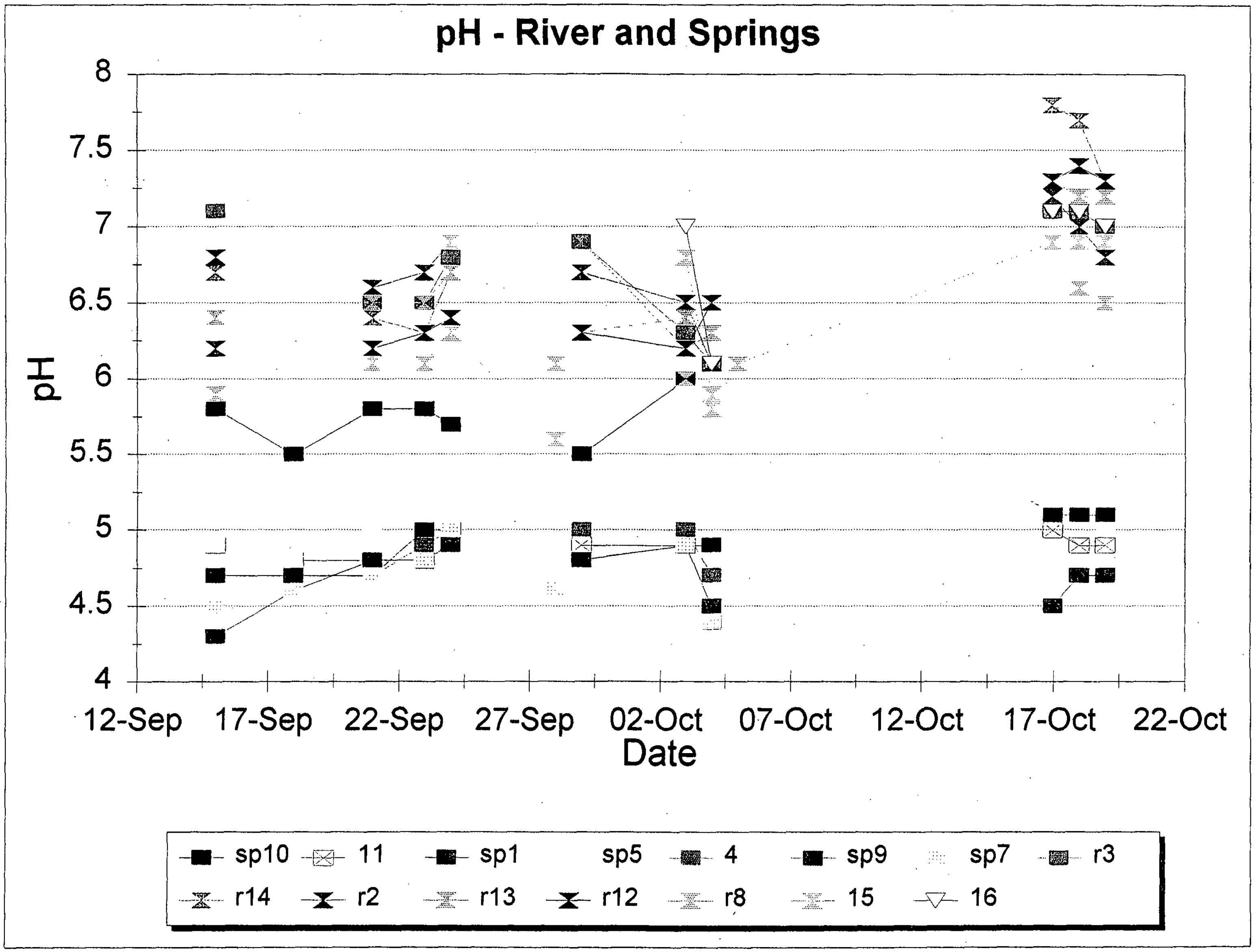
GSi/water

Temperatures (deg C) at springs and river bottom R=river; S=spring

Location	3	10	14	11	1	2	13	12	5	4	6	9	8	7	15
Type	R	S	R	S	S	R	R	R	S	S	S	S	R	S	R
09/15/96	10.76	11.06	8.31	10.95	9.63	8.69	7.83	7.95	11.74	12.26	11.14	10.53	7.96	9.8	
09/18/96		10.97		9.91	9				10.18	9.78	9.3	9.86		9.06	
09/21/96	11.48	11.55	10.24	9.48	9.45	10.14	9.64	10.54	12.38	16.06	11.7	14.25	8.11	11.66	
09/23/96	9.7	11.34	9.04	12.42	9.36	9	8.9	8.64	9.88	10.64	10.26	10.03	7.97	11.03	
09/24/96	9.12	10.68	8.84	10.72	9	8.35	8.37	8.17	11.73	11.43	9.64	9.23	7.97	9.87	10.18
09/28/96											8	9.04	8.13	9	8.82
09/29/96	10.36	11.44	9.71	10.09	9.22	10.05	10.04	10.67	12.23	12.87					
10/03/96	10.86	12.26	10.83	9.56	8.72	10.96	10.89	11.25	10.88	11.39	9.79	11.25	8.92	10.35	10.83
10/04/96	9.57	n/a	9.6	10.07	8.81	9.32	9.61	9.49	9.7	9.57	9.73	9.49	9.23	10	9.5
10/05/96													6.86		
10/17/96	5.64	n/a	5.8	7.71	7.76	5.99	5.92	5.98			n/a	n/a	7.96	n/a	6.18
10/18/96	6.89	n/a	6.42	12.46	8.66	6.68	6.3	6.32			n/a	n/a	6.77	n/a	6.45
10/19/96	7.78	n/a	7.57	9.87	8.23	6.72	7.03	7.34	9.25	8.53	n/a	n/a	7.52	n/a	7.34

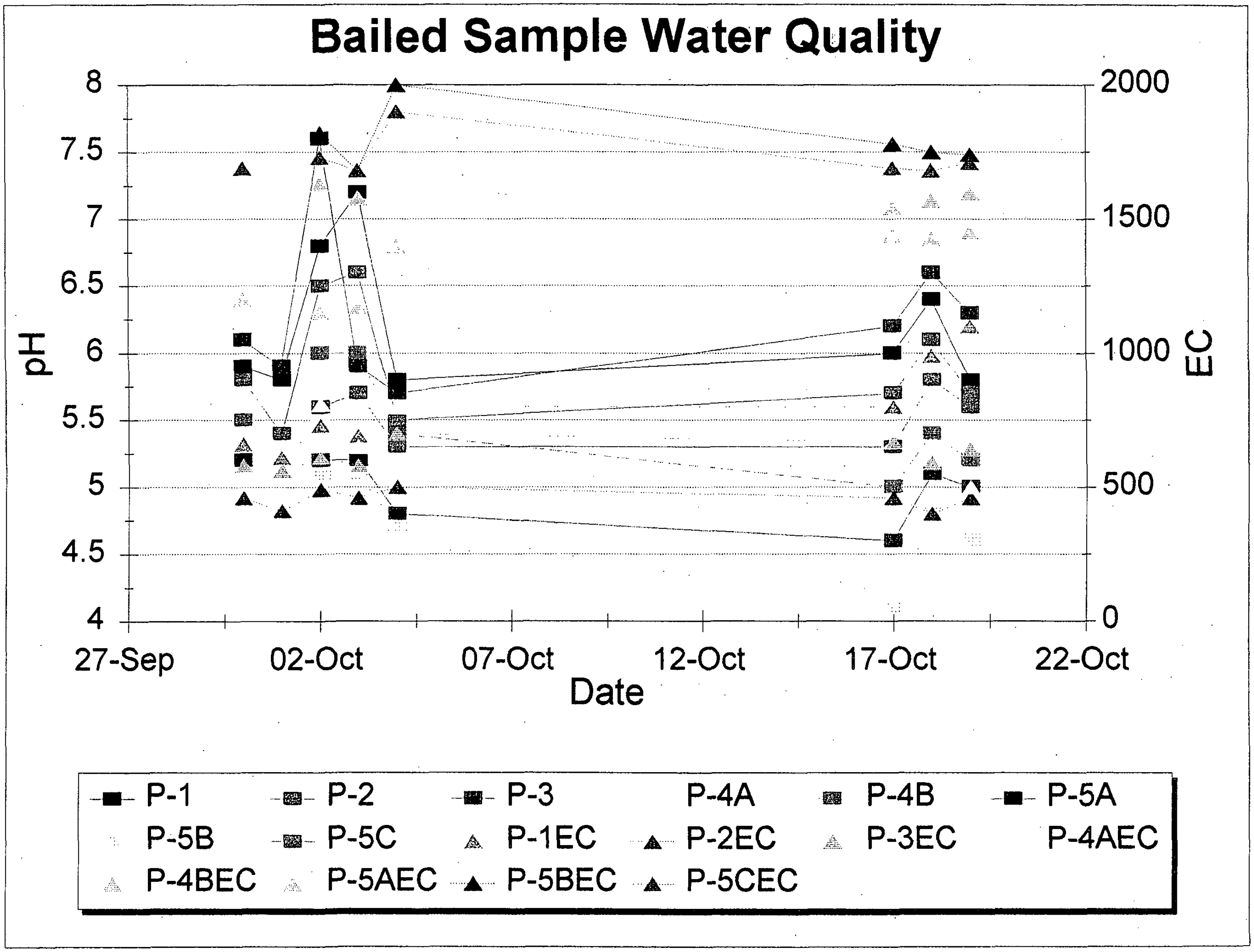
Bailed WQ:Temperature, EC and pH for all new monitoring wells

Location		P-1pH	P-1EC		P-2p	P-2EC		P-3p	P-3EC		P-4ap	P-4aEC		P-4bp	P-4bEC		P-5ap	P-5aEC		P-5bp	P-5bEC		P-5cp	P-5c
	T	EC	pH	T	EC	pH	T	EC	pH	T	EC	pH	T	EC	pH	T	EC	pH	T	EC	pH	T	EC	pH
09/30/96	12	660	5.9	14	460	5.8	11.5	580	6.1							14	1200	5.2				10	1690	5.5
10/01/96	12	610	5.8	14	410	5.4	13	560	5.9															
10/02/96	11	730	6.8	11.5	490	6.5	11	610	7.6	12	810	5.5	12	1630	6	11	1150	5.2	11	1820	5.1	13	1730	5.6
10/03/96	11	690	7.2	12	460	6.6	11.5	580	5.9	11	650	6	11	1580	6	11	1170	5.2	11	1680	5.1	11	1680	5.7
10/04/96	9	800	5.8	10	500	5.5	9	700	5.7	9	800	4.9	8.5	1900	5.4	9	1400	4.8	10	2000	4.7	9	1900	5.3
10/17/96	9	800	6	9.5	460	5.7	10	670	6.2	n/a	n/a	n/a	9	1540	5	8.5	1440	4.6	9.5	1780	4.1	9	1690	5.3
10/18/96	10	990	6.4	11	400	6.1	11	590	6.6	n/a	n/a	n/a	12	1570	5.4	11	1430	5.1	13	1750	4.8	12	1680	5.8
10/19/96	12	1100	5.8	12	460	5.7	12	640	6.3	11	500	5	12	1600	5.2	11	1450	5	12	1740	4.6	11	1710	5.6



GSi/water

000923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5
4.5
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1500
1000
500
0
27-Sep
02-Oct
07-Oct
12-Oct
17-Oct
22-Oct
Date
P-1
P-2
P-3
P-4A
P-4B
P-5A
P-5B
P-5C
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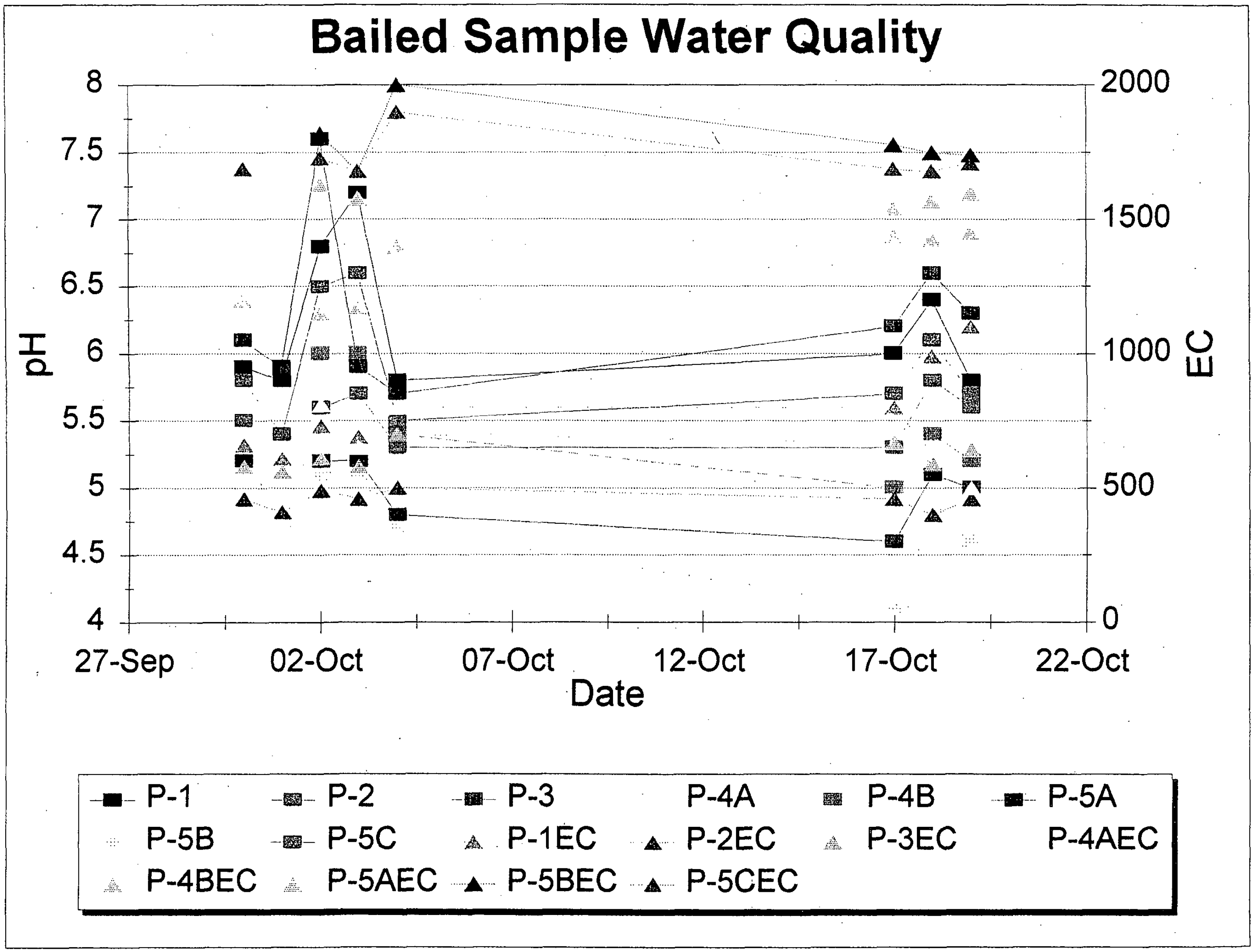
P-4AEC
P-4BEC
P-5AEC
P-5BEC
P-5CEC

GSi/water



Bailed Sample Water Quality
pH
EC
Date
8
7.5
7
6.5
6
5.5
5
4.5
4
2000
1500
1000
500
0
27-Sep
02-Oct
07-Oct
12-Oct
17-Oct
22-Oct
P-1
P-2
P-3
P-4A
P-4B
P-5A
P-5B
P-5C
P-1EC
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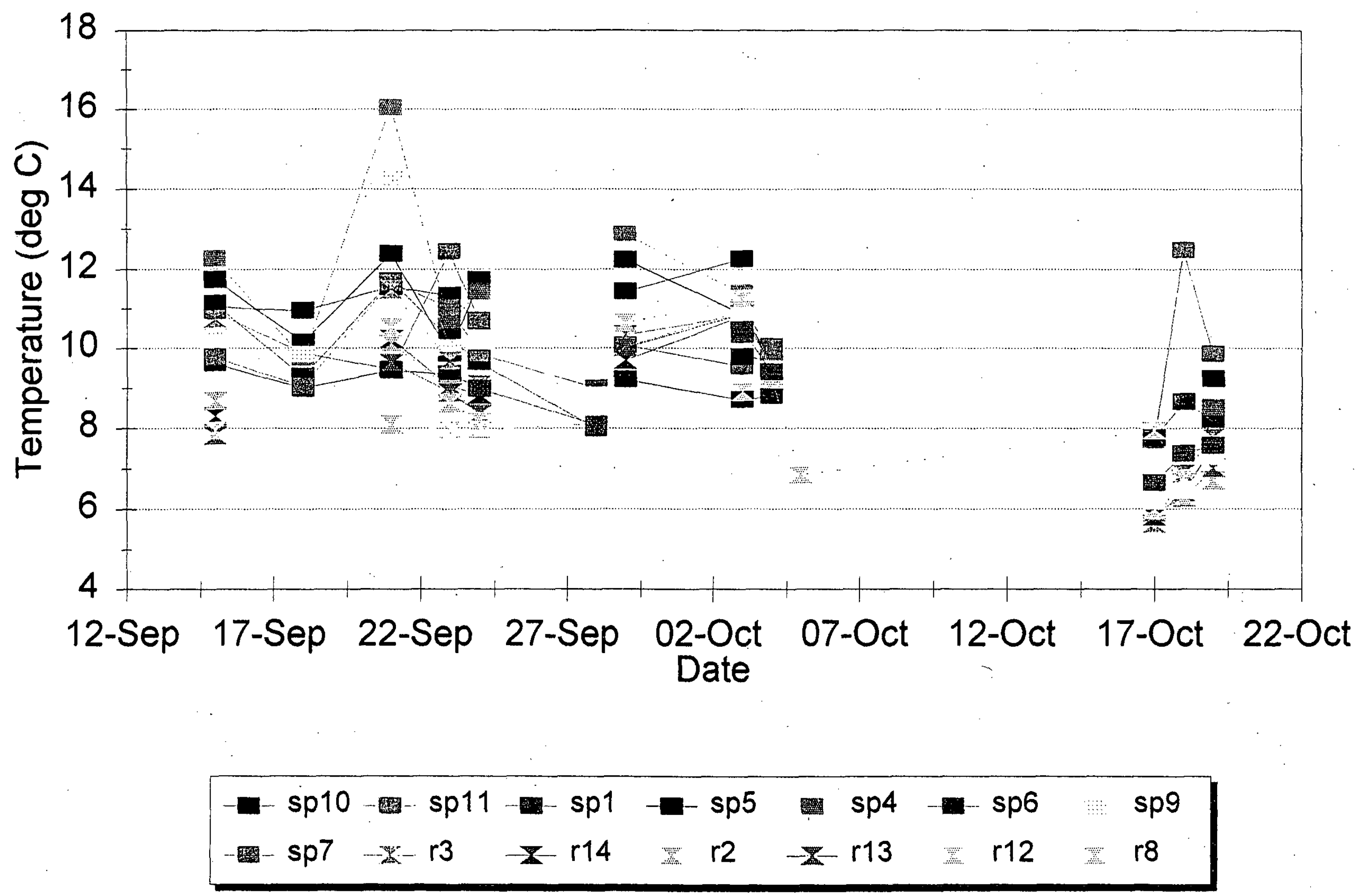
P-5CEC

GSi/water

Spring and River Bottom Temperatures



GSi/water

000926